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THE APPLICATION OF THE FORCES OF NATURE TO THE PRODUCTION OF ELECTRICAL ENERGY.

THE progress which has been made towards utilising the forces of nature through the medium of electricity has been but very little. Now and again we hear of spasmodic experiments, but practical results are rarely developed from the same. There are, of course, one or two brilliant exceptions, such for instance as the lighting of Sir William Armstrong's mansion by water power. The Portrush railway also must not be omitted, as it is undoubtedly a most striking instance of the practicability of the general principle. The Godalming electric lighting, though hardly a success, may perhaps be included in the list of practical applications; but beyond these three there are very few, if any, cases which can be cited to prove that progress has been made.

The difficulty of easily and inexpensively obtaining power sufficient to satisfy particular requirements is a great hindrance to the carrying out of the general idea. We have plenty of power existing in the tides undoubtedly, but how to utilise it without the erection of expensive embankments or the appropriation of valuble land space is a problem which has as yet received no solution.

The employment of wind power has been more than once suggested, but the intermittent character of the supply available has been a great obstacle, so that the idea does not seem to have been at any time received with favour, though the use of electrical accumulators has been suggested to enable the intermittent power to be stored.

It does not appear to us that the *mechanical* accumulation of power has yet received the attention which it deserves. A weight of 15 tons falling through a distance of 60 feet will develope one horse-power per hour; increase the weight and the distance of the fall and we have the means of mechanically storing up a considerable force. A windmill, for instance, situated near the brow of a cliff, could be made to wind up a heavy weight, and then the slow fall of the latter would give back the power with but very little loss. Such mechanical accumulation has the advantage that no loss can take place by lapse of time, and, moreover, no valuable land space is required for enabling it to be carried out. In certain cases the necessary length of fall could be obtained by sinking a pit in the ground. The use of differential pulleys, also, for obtaining a considerable linear movement with a short length of fall for the weight, suggests itself. It would not perhaps be feasible to accumulate power to any very great amount in the way we point out, but still there may be many cases where the method could be employed with advantage.

The results of past experience have proved, we believe, that in this country the price charged for incandescence electric lighting, under the most favourable conditions, must at present be at least twice to thrice that of gas, if a profit is to be made by the suppliers. Except in special cases, therefore, the incandescence system cannot as yet hope to compete with its older rival gas, especially when the price charged for the latter is falling without sensibly affecting the profits made by the gas companies. Unless, therefore, the forces of nature can be utilised to supply cheap power, the arc principle only can, with our present means, hope to hold its ground amongst electric lighting systems.

NEW METHOD OF INSULATING WIRES EMPLOYED IN TELEGRAPHY AND TELEPHONY.

By M. C. WIDEMANN.

HAVING had occasion for a year to apply, for the decoration of articles of jewellery, the procedures pointed out by Nobili and Becquerel for obtaining colouration by means of baths of alkaline plumbates and ferrates, I observed that the articles thus coloured became absolutely proof against all galvanic action; that is, their surfaces when once coated with peroxide of lead or of iron were insulated, and no longer conducted the electric current. A wire of copper, brass, or even iron, may thus be coated with an insulating layer like a stratum of resin or gutta-percha.

This principle, I believe, admits of easy utilisation in preparing wires and cables for use in telephony and telegraphy.

The method of obtaining this insulating stratum is, from an industrial point of view, very practicable, and the cost trifling. The hardness of this coating, which resists all atmospheric action, is a guarantee of its durability. The insulation is absolute.

The method of preparation is very simple. A bath of plumbate of potash is prepared by dissolving 10 parts of litharge in 1,000 parts of water, to which have been added 200 parts of caustic potash, and boiled for about half-an-hour. It is allowed to settle, decanted, and is then ready for use. The wire to be coated with peroxide of lead is attached to the positive pole and a small platinum anode to the negative. Finely-divided metallic lead is precipitated upon the negative pole, and the wire is coated with peroxide of lead, which passes successively through all the colours of the spectrum. The insulation is complete when it takes a brownish-black colour.

The wire thus covered is perfectly insensible to electric action. Articles perfectly cleaned may be attached to it, and connected with the negative pole of a gilding, silvering, or nickeling bath without the current, however powerful, producing any action upon the objects to be coated. Such a wire, if placed in a circuit, and brought in contact with another wire in connection with a galvanometer, leaves the latter entirely unaffected.—*Comptes Rendus.*

Another Cable Company.—A certificate of incorporation of the Postal Telegraph and Cable Company was filed, says the New York *Electrical World*, in the office of the county clerk, on Friday, October 19th. The company proposes to have a cable from Greenport, L. I., to England, to be connected with telegraphic lines throughout Europe, the United States, Canada, and Mexico The incorporators are Henry C. Gardner, Luther R. Marsh, F. H. Dupuy, Andrew W. Kent, and Dumont Clark.

REVIEWS.

Dictionnaire d'Électricité et de Magnétisme, étymologique, historique, théorique, technique; avec la synonymie Française, Allemande, & Anglaise. Par ERNEST JACQUEZ. Paris: Libraire, C. Klincksieck, 11, Rue de Lille.

We are a little doubtful whether there is any real need of books of the present description. It is true they have a ready sale, but every electrician makes a point of possessing any new electrical work that makes its appearance, irrespective of the probability of its being of use to him. If the want really exists, M. Jacquez has supplied it in a most satisfactory manner. There are evidences that the author has left no stone unturned in order to make his work as complete as possible. To compress information into a very small space without producing what are practically meaningless statements is a difficult matter, but M. Jacquez has proved himself equal to the task he has undertaken. To such as feel the want of a work of the kind we can heartily recommend the book.

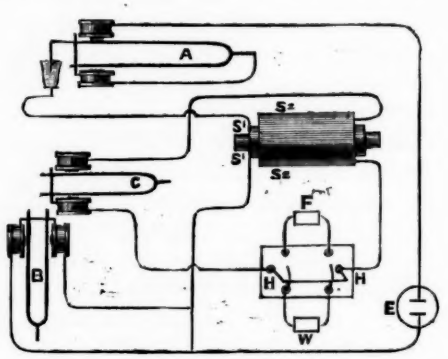
A Practical Treatise on Lightning Protection. By H. W. SPANG. New York: D. Van Nostrand, 23, Murray Street and 27, Warren Street.

This treatise gives complete and explicit instructions for the protection of buildings, and explains the defects of the lightning conductors now erected. The author is a strong advocate of a "radial system" of conductors, which consists essentially in having the latter at each corner of the building, the four being united at their top ends with air terminals upon the ridge at or near each end of the structure. Such an arrangement would, of course, be highly efficient, though it does not possess any element of novelty, nor do we think there is the slightest necessity for rigidly adhering to it. The book, though it consists of but 60 pages, contains much useful information and is not open to the criticism which, we think, may be justly applied to many books of the kind, viz., that the matter is "much ado about nothing." On page 42 we come against the statement which is met with in almost every modern treatise on electricity and its allied subjects, namely, that "a lightning conductor will protect a circular space the radius of which is equal to twice its height above the ground or above the roof of the building;" as usual, the writer takes the trouble to point out the fallacy of a law which was, in the plainest language, officially withdrawn in the *second* report of the French Committee on lightning conductors, with which it originated. We wonder how often this law is to be copied and re-copied as if it had never been directly contradicted by the authors of it. In page 56 the "Latest Lightning Humbug" is criticised in plain language, without any attempt to avoid giving the lie direct. This system is that of a Mr. J. C. Chambers, and is being worked by a "Chambers National Lightning Protection Company." The system consists of an iron rod placed along and above the ridge of a building with points at each end projecting upward, the whole being supported on glass insulators; *no earth connection is used.* The efficiency of such an arrangement may be imagined.

ON THE CHANGE OF PHASE IN RECIPROCATING CURRENTS EFFECTED BY POLARISATION.

By A. WINKELMANN.

F. KOHLRAUSCH has shown that the course of reciprocating currents undergoes a twofold change by the introduction of a polarising stratum of liquid. There is produced on the one hand a displacement of the vibration phase, and on the other an alteration in the strength of the current. The latter change has been utilised by Kohlrausch for measuring the magnitude of polarisation, whilst Overbeck has studied the displacement of phase in order to utilize it for the same purpose. Both observers apply the sine-inductor for the production of reciprocating currents and observe their action by means of the electro-dynamometer. As the distribution of the intensity of the currents thus produced follows the simple law of sines, the instruments are very suitable for a closer examination of the difference of phases which appears. It was, however, to be expected that induction currents, produced in the ordinary manner, would undergo a displacement of their curve of intensity which might be made visible by suitable means. The author has verified this supposition by means of an electric tuning-fork apparatus. The arrangement for the experiments was as follows:—



Of three tuning-forks, A, B, C, brought as closely as possible into unison, A served for an interruption fork, B, with its prongs upright, supported the object glass of a microscope; a silver globule, illuminated by a lamp, was supported upon the horizontal prongs of the fork, C, and was observed through the microscope. The current of the battery, E, traversed the coils of the electro-magnets, the interruption apparatus of the fork, A, then the primary spiral, S, of an induction apparatus without condenser, and finally in a branch conduction the coils for the fork, B. The coils of the secondary spiral, S_2, were connected on the one hand with the coils of the fork, C (the prongs of which were magnetised), and on the other hand with the balance, H, H, with which the second end of the coils of the fork, C, was likewise in connection. By means of this balance the liquid under examination, F, or another resistance, W, could be alternately introduced into the circuit of the induction-current.

Soon after the apparatus was excited there appeared, on observation with the microscope, a fixed luminous curve, the form of which depends on a variety of circumstances. Firstly, the time of vibration of the freely-vibrating forks has its effect; then the strength of current of the battery, and finally the magnitude of the resistance which is introduced into the induction current. If any of these factors is modified there appears a change not only of the amplitude but of the phase of both forks, which is recognised by a displacement of the luminous curve. This may be explained by the influence of the magnetism, which does not reach its greatest intensity simultaneously with the maximum of the current, and by the induction of the moving prongs of the forks. These modifications of the phase disturb the observation of the influence of polarisation, but still allow it to be distinctly recognised under certain circumstances. The following arrangement appeared suitable:—

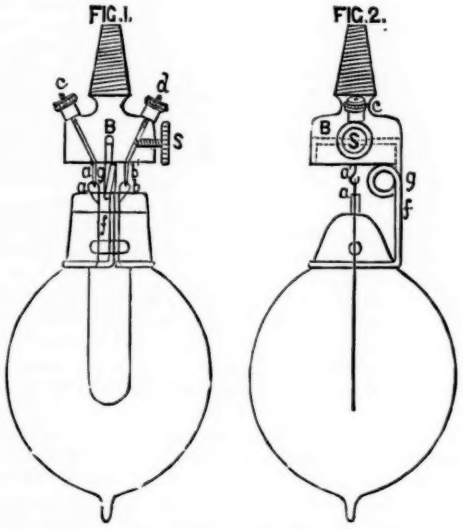
There was employed for the resistance, W, a glass trough, filled with a saturated solution of sulphate of copper, into which were plunged copper electrodes. In this manner a resistance is obtained which can be continuously changed, and has a very slight polarising action. For a polarising liquid, either dilute sulphuric acid or saturated brine was used. The electrodes were of bright platinum, and were from 20 to 45 square millimetres in area. After exciting the apparatus the branch circuit to the fork, B, is arranged so that the amplitudes of

both forks are about equal. By fixing small balls of wax upon B, or C, the ellipse observed is made to pass into a straight line, inclined at about 45° to the horizon. To mark its position an eye-piece micrometer was adapted to the microscope; its lines could be placed parallel to the luminous line by turning the eye-piece. If the resistance, W, is now altered by removing the copper electrodes from each other there occurs a slowly progressive change of the straight line which passes into an ellipse whose minor axis increases whilst its major decreases, and at the same time turns in such a manner that it approaches the horizontal position.

If the induction current is next allowed to pass through the polarising fluid the curve changes, and it cannot be pronounced beforehand, whether this change is occasioned merely by a change in the resistance or not. But it is easy to find a resistance, W, such that on tilting the balance the curve undergoes a characteristic change. On applying the copper solution the major axis of the ellipse, whilst decreasing, becomes more horizontal, but the resistance of the copper solution can be so regulated, that on turning the balance the major axis decreases, and at the same time becomes more perpendicular. It follows from what has been already said that this must be occasioned solely by a difference of phase, which the primary and secondary currents undergo in respect to each other. In the author's apparatus the displacement of the end of the major axis amounted to $\frac{1}{20}$ of its length. A more accurate measurement would have no value. The forks vibrated 210 times per second.—*Wiedemann's Annalen.*

HIGGS'S PATENT INCANDESCENCE LAMP HOLDER.

THIS holder, the invention of Dr. Paget Higgs, is extremely simple in construction and enables the lamps to be fixed in position with extreme facility. Figs. 1 and 2 show the arrangement of the holder. The two platinum loops, *a*, *b*, on the glass globe, hook into



two hooks, *a'*, *b'*, fixed in the wooden boss, B. The two hooks are connected respectively to the two terminals, *c* and *d*, the connection of the latter being interrupted by a gap which can be bridged over by screwing up the screw, S; the latter, therefore, acts as an interrupter of the current. The wire, *f*, is fixed into the wooden boss, B, and has a loop, *g*, in it, so as to give it a spring action and thus keep the platinum loops of the globe firmly in contact with the connecting hooks.

At the Crieff Dye Works, where there is an installation of 500 lamps, Dr. Higgs's holders are used throughout.

THE FERRARIS UNIPOLAR MACHINE FOR ELECTROLYSIS.

EXPERIENCE has proved that the best arrangement of electrolytic baths is that where the component elements are grouped for quantity, so as to reduce the electromotive force of reaction to that of a single element and the resistance of the baths to a minimum, the elements being thus rendered mutually independent. But this independence is only very relative if we have not at our disposal a source of electricity of constant tension, so that the number of the elements may be modified without changing the arrangement of those which remain in activity.

If we call E the electromotive force of the machine which produces the current, ε the potential of the current at the limits of the machine, and e the electromotive reaction force of the bath; let I be the intensity of the current, R the internal resistance of the machine, and ρ that of the external circuit of the baths, we have:

$$E = I R + \varepsilon \qquad \varepsilon = I \rho + e$$

whence we may deduce the value of the potential of the current produced

$$\varepsilon = \frac{\rho E + R e}{\rho + R}$$

This potential is chosen beforehand with reference to the electromotive force e of the reaction, and it is generally made $\varepsilon = 2e$; on introducing this value into the formula we obtain, as the condition of the constancy of potential of the current to be produced:

$$E = \left(\frac{R}{\rho} + 2\right) e$$

There are two means of fulfilling this condition: the first is to cause E to vary inversely as the resistance ρ of the circuit of the baths in the proportions indicated by the formula. This is possible only within certain limits with inductors excited by the current of the baths when the magnets are near the point of saturation. This is the system generally adopted for electrolytic machines, and has the inconvenience of employing a large quantity of copper in the circuit of the inductors, in order not to oppose too much resistance to the very intense current produced, if only for very slight variations in the resistance of the circuit of the baths.

The most rational means is to keep the electromotive force, E, of the machine constant, and at the same time to reduce its internal resistance, R, to zero.

The former condition is fulfilled either by exciting the inductors with a constant external source, or even with a current derived from the same machine when the resistance of the shunt of the conductors is very great in proportion to that of the principal current. It is more difficult to fulfil the second condition, approximating the resistance of the ring of the machine as closely as possible to zero when it is required, as in the case of electrolysis, to produce very intense currents of a very feeble potential; in fact, the experiments of Isenbeck prove clearly that in rings with two polarities only a small part of the coil enters into play in the production of the current, whilst the larger portion is merely a useless weight, and is even injurious, and the current which is induced in it serves merely to heat the conductors. Further, the collector, which opposes merely a very slight resistance to the passage of currents of high tension, constitutes a resistance so much the more considerable as the potential of the current becomes smaller.

All these considerations bring us to unipolar machines, where there is no inversion of current, and where it is easy to let the current issue by large surfaces of contact; with them it is possible to reduce the internal resistance at pleasure, provided we increase in the same proportion the intensity of the magnetic field, or the speed of the ring. Thus the unipolar system is that which gives the least heating of the machine and the greatest useful effect, besides the greatest constancy of potential. Unfortunately we do not yet

possess a machine which realises in practice the advantages of the system, though the solution of the problem has been attempted by eminent physicists, such as Siemens, Ferranti, and others.

Having been for a long time engaged with electrolysis from an industrial point of view, I have attempted to construct a machine which answers the above-mentioned conditions, and I now publish the design, believing that it will be useful to all those who are convinced that a great future awaits electricity as a means of transforming kinetic energy into molecular work, and as a substitute for thermic energy, in its applications to chemical and metallurgical industry. The machine which I describe has been constructed in the workshops of the mine of Monteponi in Sardinia, to be employed in experiments on the treatment of lead and zinc by electricity. It is based upon the fundamental idea of Siemens, and presents itself in a practical form, simple and of an easy construction. (V. fig. 1 and 2.)

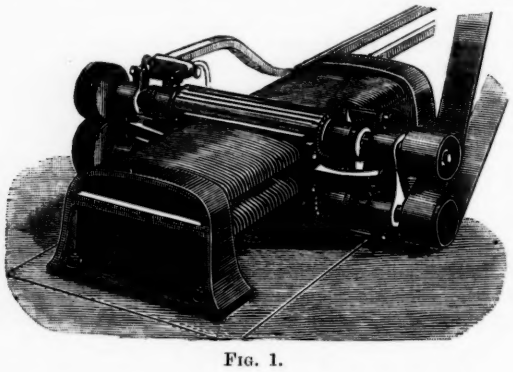


FIG. 1.

The magnets are two in number, and of horse-shoe form, connected by their ends of like polarity. Between them they leave two cylindric spaces destined to receive the revolving armatures. We have thus two intense magnetic fields of different polarities, the one above and the other below the polar expansions of the magnets, the lines of force of which are collected by the two axles of the armatures, these axles being connected together by two friction pulleys, and form thus a horse-shoe armature, magnetised by the electro-magnets. The axles and pulleys are, of course, of soft iron. Around the axles, and insulated from them, there are two cylindrical armatures, composed of bars

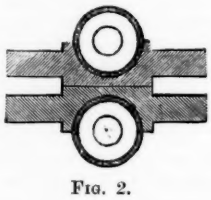


FIG. 2.

of copper, which leave between them a small play room, fixed at their ends upon discs of copper.

The current produced by the rotation of the two armatures being of an opposite direction, the armatures are connected on the one hand by collars joined together, whilst conductor collars placed on the other side separate the two conductors from the outer circuit, and even from the circuit of the magnets, if it is desired to excite them by a current derived from the same machine. The whole system of the armatures is insulated from the revolving axles, and the armatures are connected in tension in order to double the electromotive force of the current.

To diminish as far as possible the friction of the collars upon the necks without having recourse to oil, which would hinder the passage of the current, the interior surface of the necks is fitted with lubricating rods, composed of an alloy of thallium, which is often used for the automatic lubrication of loose pulleys, &c.

The bars intersect normally the lines of force, which are strengthened as much as possible by filling the space between the axle and the copper armature with small discs of iron, not shown in the figure. The small space between the discs and the bars, and between the bars themselves, produces a ventilation sufficient to cool the armature.

The circuit of each branch of the electro-magnets touches a commutator, as well as the conductors of the shunt intended for excitement. The magnets may be grouped at will in tension or in quantity, or in two tension-groups connected with each other in quantity. We have also the means of changing the system of excitement either by derivation or by the current of an auxiliary machine, and of introducing into the exciting circuit resistances which serve to graduate the magnetic field and the electromotive force. By means of the intercalated commutator (the design of which does not require to be given) we have the choice of the potential of the current to be produced within very wide limits. The machine may be applied without any modification to many electrolytic operations which require currents of different tensions.—ERMINIO FERRARIS (*La Lumière Electrique*).

OVERHEAD WIRES.

FROM the account of a meeting held on the 1st November, at the Marylebone Court House, a report of the proceedings of which we give below, it would appear that the vestries and district boards are about to take active steps to test their powers over the erection of overhead wires.

That legislation is necessary there cannot be any question, but at the same time it is one that requires careful consideration, and one on which we think far more careful legislation is necessary than it would probably derive at the hands of the vestries should they gain their point.

Any one acquainted with the metropolitan vestries must be well aware that they are not always the most practicable bodies to deal with. Should, therefore, the former obtain the control over the erection of all overhead wires in their parishes, it might prove rather a bad look-out for the various telegraph and telephone companies.

The question of all wires being put underground is not so easily solved as at first sight might appear. For every telegraph, telephone, or electric light company to be permitted to open up the roadway or pavement for the purpose of running wires would be out of the question. Even the blocking of the traffic by the postal authorities is quite inconvenient enough, and when it became a question of competing companies would be quite unbearable.

Subways under our principal streets would certainly facilitate matters, and surely in the laying down of all new streets it is a point that might well be considered.

It would appear to us that until some alternative can be devised, overhead wires will have to be permitted. Certain restrictions and rules, however, should be laid down, and these, in the public interest, should be common to the metropolitan district. If necessary, special officers might be appointed to see those rules carried out, just in the same way as district surveyors have to supervise all buildings. Were this course adopted, the great supposed danger of overhead wires would be minimised, and the public and vestrymen might once again feel secure.

MARYLEBONE UNITED COMMITTEE AND OVERHEAD WIRES.

A NUMEROUSLY-ATTENDED meeting of the Marylebone Vestry was held on Thursday of last week, at the Marylebone Court House, for the purpose of considering the report of a united committee of that and other

metropolitan parishes with respect to the present and daily-increasing dangers of telegraph and telephone wires over the thoroughfares, and the powers which the local authorities possess to prevent the erection of such wires in their respective districts, or to regulate the same. Mr. Charles Walker, churchwarden, presided.

Mr. W. E. Greenwell, the Vestry Clerk, presented the report, which recommended that one local representative body, acting for the whole of London, should take action forthwith in order to test the powers of existing law on the question; that the vestry of St. Marylebone be invited to take such action; and it was suggested that they should issue notices to all persons having wires in or over the streets of the parish, calling upon them to make application to the vestry for permission to continue the same; that in the case of every existing wire for which application should not have been made within 14 days of the issue of the notice for permission for its continuance, such wire or wires shall be disconnected under the superintendence of the surveyor of the parish on the order of the vestry, and that no new wire shall be laid under or raised over the thoroughfares of the parish until permission has first been granted by the vestry; that in case of an appeal following such action by the vestry of St. Marylebone on behalf of the whole of the local authorities of the capital, each of the vestries and district boards assenting to such action should bear a share of the costs *pro rata;* that the report be printed and copies sent to the Prime Minister, Home Secretary, President of the Local Government Board, Postmaster-General, Metropolitan Board of Works, Lord Mayor, and vestries and district boards of the metropolis.

Mr. Greenwell, Vestry Clerk, read a letter from St. George's Vestry, Hanover Square, accompanied by a report repeating that the Government had declined to take any steps in the matter, and repudiating any responsibility for accidents that might occur.

Mr. Endean, as chairman of the joint committee of the parishes, moved, "That the report of the joint committee be approved, and that steps be taken by the vestry of St. Marylebone to test the right of control of the local authorities, leaving open for the present the special mode of procedure suggested by the joint committee."

Mr. Gliddon seconded the motion.

A discussion ensued, in the course of which reference was made to the inconvenience and danger caused by the breaking of overhead wires in the City and elsewhere in the metropolis.

Mr. Neale said, having himself cut the wires of a certain company which had persisted, in defiance of his refusal of sanction, to carry wires over his house top, and actually fixed them to his chimney shaft, he was threatened with no end of pains and penalties; but finding him determined on resistance, they had now altered their tone and begged him to say no more about it.

Mr. Galsworthy said there was no doubt that these overhead wires were a constant danger to the public, especially under peculiar atmospheric influences; but at the same time he advised the vestry not to be precipitate. He moved as an amendment, "That the consideration of the subject be adjourned for a fortnight, that a copy of the committee's report be sent to St. George's Vestry, and that a copy of the report of the St. George's Vestry be forwarded to each member of the vestry of St. Marylebone."

Mr. White seconded the amendment.

Mr. Vesey denounced interfering in the matter. He thought it was a good job the local authorities had no power over these overhead wires, as they would necessitate the employment of a large staff of men to keep them in order.

Mr. Edwards, member of the Metropolitan Board, supported Mr. Galsworthy's amendment, and ultimately

Mr. Endean withdrew his motion, and the amendment becoming the substantive proposition, was put and carried unanimously.

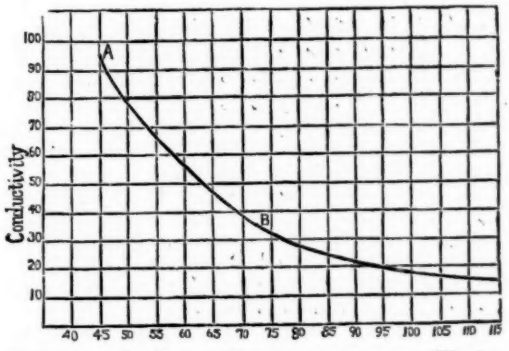
SILICIOUS BRONZE CONDUCTORS.

THE overhead lines intended for the transmission of telegraphic and telephonic despatches, or of power to a distance, are at present manufactured of iron, steel, compound wire, or silicious bronze.

When electric telegraphy was first introduced it was natural to use copper wires for forming the lines; but copper has but little mechanical strength, and it lengthens considerably under its own weight. A telegraph line of copper, erected in 1848 between Paris and Rouen, became considerably lengthened at the expense of its section, which, diminishing, also lessened the conductivity of the line. The result of this was that the copper was abandoned and replaced by iron or steel, which offer sufficient mechanical strength but possess less conductivity.

In America the respective properties of copper and steel have been turned to account by combining the two metals. The first compound wire was steel covered with copper by electro-deposition: it is now made by rolling a band of copper round a wire of tinned steel,* passing the whole through a drawplate and soldering it by immersion in a bath of tin. In France steel wire has been manufactured $\frac{1}{4}$ of a millimetre, covered with a layer of copper 0·2 millimetres, weighing 29 kilogrammes per kilometre; it broke under a weight of 150 kilogrammes, and had a conductivity somewhat above that of galvanised iron wire of 3·5 millimetres. By this means great tenacity with a sufficient conductivity was combined with slight weight, which would prove of considerable economy in transport, and simplify the construction of lines. We should also obtain a given conductivity with a smaller section, which would lessen the mutual induction of the wires, but the experiments made up to the present have not sufficiently proved that the adherence of the two metals would be maintained; therefore the employment of compound wires has not yet entered into industrial practice, in France at least.

For some years M. Lazare Weiller has been manufacturing silicious bronze, which possesses all the mechanical and electrical qualities of the compound wire without having its disadvantages. The silicious bronze, in fact, presents a conductivity equal to that of pure copper, while at the same time it has a higher



Resistances to breakage in kilogrammes per square millimetre.

MECHANICAL STRENGTH AND CONDUCTIVITY OF THE SILICIOUS BRONZE.

mechanical strength than the best iron. This mechanical strength may vary considerably, according to the purpose for which the wire is intended. Between the mechanical strength and the conductivity there exists a relation, which is clearly shown by the curve in the above diagram, the wires of highest conductivity being those which offer the least strength, and *vice versâ*. In this curve the mechanical strengths in kilogrammes per square millimetre are plotted out in abscissæ, and the corresponding conductivities in ordinates, the conductivity of pure copper being taken as 100.

For telephonic lines, slight wires of considerable

* The reverse of this explanation appears to be the true one.—EDS. ELEC. REV.

length are necessary; the mechanical resistance should be as high as possible, in order to withstand shocks, wind, and to lessen the number of supports without increasing the strain upon them; a moderate conductivity is sufficient, if we take into account the nature of the telephonic currents. For telegraph lines, especially the great international lines in constant use, we require, on the contrary, the maximum of conductivity. If we employ iron, we can only attain this with considerable diameters, and thus the wire is transformed into an unmanageable bar of iron. The bronze wire gives the same conductivity with a smaller diameter, if we choose a type of good conductivity, but presenting, at the same time, a sufficient total mechanical strength.

The points A and B of the curve represent two types employed by the post and telegraph authorities, which characterise these two special applications.

(1.) *Telegraph wire* (A). 2 millimetres in diameter, having 45 kilogrammes of mechanical strength per square millimetre and 95 per cent. of conductivity.

Diameter in millimètres.	Section in square millimètres.	Resistance in ohms per kilomètre at 0° C.	Weight in kilogrammes per kilomètre.
	TELEPHONE WIRES.		
1·00	0·7854	64	6,940
1·05	0·8655	58	7,655
1·10	0·9503	57	8,455
1·15	1·0383	48	9,167
1·20	1·1310	44	10,036
1·25	1·2252	40	10,850
1·30	1·3273	38	11,748
1·35	1·4294	35	12,638
1·40	1·5394	32	13,617
	TELEGRAPH WIRES.		
1·25	1·2252	13·97	10,850
1·50	1·7671	9·68	15,660
2·00	3·1416	5·43	27,960
2·25	4·4741	3·81	39,780
2·50	4·9087	3·47	44,010
2·75	5·9380	2·87	52,770
3·00	7·0685	2·41	62,910
3·50	9·6211	1·77	85,610
4·00	12·5664	1·36	111,780
4·50	15·9043	1·13	141,510
5·00	19·6349	0·87	174,700

(2.) *Telephone wire* (B). 1·1 millimetres in diameter, having from 70 to 80 kilogrammes of mechanical strength per square millimetre and 34 per cent. of conductivity.

These diameters relate to lines of average length. They can be modified at will, according to the conditions required by different systems.

The accompanying table gives the various particulars relating to silicious bronze telegraph and telephone wires of different diameters. It enables us to ascertain the cost of a line of given length from the weight of bronze that it will require, cost of transport, &c.

We now give, in order to facilitate comparisons, a table which sums up the principal properties of the different wires employed up to the present time, copper, iron and steel. The kilometric resistance relates to a wire one millimetre in diameter.

Description of Wire.	Resistance to breakage per sq. millimetre.	Kilometric resistance at 0° C.	Conductivity.
	Kilogrammes.	Ohms.	
Pure copper	28	20·57	100
Silicious bronze (telegraph)	45	21·42	96
,, ,, (telephone)	76	64·00	34
Phosphor bronze (telephone)	72	78·00	26
Swedish galvanised iron ...	36	135·20	16
Bessemer galvanised steel	40	156·00	13
Siemens-Martin steel ...	42	166·80	12

We can substitute for telegraph wires, five millimetres in diameter, weighing 155 kilogrammes per kilometre, silicious bronze wires, of two milimetres diameter, weighing 28 kilogrammes per kilometre, and for ordinary steel telephone wires, of two millimetres, weighing 25 kilogrammes per kilometre, silicious bronze wires, of 1·1 millimetres, weighing 8·45 kilogrammes per kilometre.

Thus, the lines being much slighter, they bear more lightly on the poles, so that the latter can be reduced in dimensions and placed farther apart; in conclusion, let us add to the advantages already enumerated, the non-liability of the wire to oxidation and the diminution of the injurious influence of induction.

The variation in resistance of the silicious bronze with the temperature is very slight. Between 0° and 50° centigrade, M. O. Leblond gives the following formula:

$$R_t = R_o (1 + k t).$$

R_t, resistance at the temperature t.
R_o, resistance at the temperature 0°.
k, co-efficient, the different values of which are as follows:

Iron	0·00472
Copper	0·00402
Phosphor bronze	0·000743
Silicious bronze	0·000740

The variation in resistance with the temperature is therefore very slight and may be altogether disregarded in practice.—*L'Electricien.*

BENNETT'S SYSTEM OF OVER-HOUSE CONSTRUCTION.

THE difficulty of providing accommodation on the roofs of the houses for the enormous and ever-increasing number of wires with which the telephone companies have to deal in all our principal towns and cities, has led to the trial of many ingenious forms of structures in wood and iron, in the designing of which utility has almost invariably been the only object aimed at, beauty being left to take care of itself. Mr. A. R. Bennett, the engineer for Scotland and Ireland to the National Telephone Company, Limited, has, however, contrived to steer a middle course, and while making an iron standard carry more wires in a given space than any other engineer has ever succeeded in doing, has produced a design which compares very favourably in appearance with any other house-top "ornament" with which the telephone companies have as yet favoured us. The good looks of the standard are due, in a measure, to the use of Mr. Bennett's corrugated shackle insulator, described and figured in our issue of Feb. 10, 1883, and to the long iron arms which support them. These arms are 5 feet in length, and are arranged to allow a space of 16 inches between the two inner wires, which is amply sufficient to allow the passage of even a bulky linesman. The full details are as follows:—

A 20-feet iron angle standard is fitted with Bennett's 6-wire clips and Bennett's shackle insulators. Capacity of standard, 120 wires; number of wires already fixed, 60; Measurement of standard, 20 feet high, 3 inches ex. diameter, $\frac{3}{16}$ inch thick; clips, 5 feet long; distance between two inner wires, 16 inches, between outer wires, 11 inches; vertical distance between clips, 11 inches; wires of phosphor-bronze, No. 18 B.W.G.; angle of majority of wires, 102 degrees. When it is remembered that on the old plan of fixing one wire below another, which is still adhered to by most telephone companies, a 20-feet standard with wires 11 inches apart, would be full with 22 wires, the gain of space attained in Bennett's system will be duly appreciated.

The Forthcoming Berlin International Telegraph Congress.—At this congress, which will be held in Berlin next year, it is expected that further important reductions in the tariff will be agreed upon.

NOTES.

Electric Lighting.—The London Brighton and South Coast Railway Company has decided to light its new station at Brighton with the electric light, and has placed the work in the hands of the Hammond Electric Light and Power Supply Company, which has already other contracts in that town.

Tenders are invited for lighting the Central Square, Spitalfields Market, by electricity. Full particulars may be had from Mr. H. Lovegrove, surveyor, 26, Budge Row, Cannon Street, E.C.

Messrs. Norman and Son, electric lighting engineers, Glasgow and Barrow-in-Furness, have contracted with the directors of the Caledonian Railway Company to lay down an arc-light installation at the Grangemouth Docks. The Burgh Commissioners of Grangemouth are about to open negotiations with Messrs. Norman and Son to take the streets in hand along with the lighting of the docks.

The Thomson-Houston Electric Light Company, of America, has a capital of $1,000,000, and its factory, which has been in operation since July, is turning out about two 12-light and one 20-light dynamo machines, with lamps complete, each week. The company has many lamps in operation in the streets and stores of Montreal, and local companies are forming in Quebec, Toronto, St. John, N.B., and other Canadian cities, to introduce the light.

The Phœnix Electrical Company of Canada (Craig system) announces that it has contracted to furnish the city of Pueblo, Mexico, a plant for lighting that city, consisting of four dynamos producing forty lights each, and a sixteen-light dynamo with 175 street lamps of 2,000 candle-power each, 100,000 carbons, 120,000 feet of cable and all the usual adjuncts.

An American exchange just received, states that one of the electric light wires belonging to the United States Illuminating Company, running under the elevated railroad structure near the station at Twenty-eighth Street and Third Avenue, New York, was broken on the night of the 13th and fell across the telegraph wires below it. The friction destroyed the insulating material covering the electric wire, and when the naked wires came in contact, the telegraph wires were burned out and rendered useless.

The Crompton-Winfield Electric Lighting Association has successfully introduced the electric light at the works of the Leeds Forge Company, Armley, and those of Messrs. Thwaites Brothers, engineers, Bradford. In both six arc lamps of 2,000 candle-power are employed.

According to the *Echo*, the Edison system of lighting, which has been in use in New York for more than a year, broke down suddenly one night last week, and nearly five thousand lights were extinguished just when they were most needed. Many of the restaurants had to resort to candles.

The new s.s. *Adelaide*, built and engined by Messrs. David and William Henderson & Co., Meadowside, Glasgow, to the order of the Adelaide Steamship Company, Limited, South Australia, for their service between Adelaide and Melbourne, which proceeds to Melbourne by way of the Cape early next week, is lighted throughout with Edison's incandescent electric light, fitted up under the supervision of Principal Jamieson, the current being obtained from a dynamo driven by a Westinghouse patent high-speed engine, supplied by Messrs. Malley & M'Lellan. The dimensions of the *Adelaide* are,—length, 279 feet; breadth, 33 feet; depth, 25 feet 4 inches., with a gross tonnage of about 1,700 tons.

Telephonic.—Telephonic communication has been established between Charlestown and Jacksonville, 454 kilometres apart, and between Jacksonville and Savannah, 278 kilometres from each other.

The Chief Constable of Rochdale, in his annual report, just issued, calls attention to the inefficiency of the present fire alarm system, and says :—"Something more to the purpose could be erected at very little cost. I trust you may see your way ere long to establish telephonic communication with the out-district stations, which, apart from giving fire alarms, would render highly important service in the detection of crime, and assist in police work generally."

The Portsmouth Chamber of Commerce has invited the Town Council to co-operate with it in urging upon the Postmaster-General the necessity for a telephone exchange at Portsmouth. The West of England United Telephone Company has expressed willingness to instal one at an annual charge of £12 for subscribers using the exchange between 9 a.m. and 7 p.m., and £14 2s. for subscribers requiring night service. The radius proposed is one mile.

The Liability of Telephone Companies.—In the City of London Court, on Tuesday, before Mr. Commissioner Kerr, the case of Velock v. the London and Globe Telephone Maintenance Company was heard. The plaintiff carries on business in the City as a wholesale mantle merchant, and claimed damages in respect of injury to a quantity of ladies' ulsters through the alleged negligence of the defendant company's servants. It appeared that the defendants' men were fixing wires on the roof of the plaintiff's premises, when some of the bricks and mortar of the chimney stack were knocked down into the plaintiff's show-room and did the damage complained of.—For the defence the defendants' superintendent was called, and said he visited the plaintiff's show-room and inspected the goods. They were but slightly damaged, and for that the company had paid £2 into court as sufficient to satisfy the plaintiff's claim.—The Commissioner: Well, that is an admission of the company of their liability. I cannot decide the question of damages the plaintiff is entitled to, but, by consent of the parties, will send that to a reference.—The amount of damages was accordingly referred.

Telegraphic.—The Postmaster-General has been granted permission to erect a line of telegraph through the district of Turton. The line will go from Manchester to Burton, Turton and Darwen.

Tampering with Racing Telegrams.—John Edward Garside, Septimus Lockwood Lamb, and Henry Hulme, convicted of intercepting telegraphic messages at Manchester on the 4th of September last and other days, were sentenced at the Manchester Assizes, on Tuesday—Garside to six months' imprisonment with hard labour; Lamb and Hulme respectively to 12 months' imprisonment with hard labour.

The Institution of Civil Engineers.—The sixty-sixth session will begin on Tuesday. The course of lectures on the "Practical Applications of Electricity," delivered this year, was so fully appreciated, says the secretary, that it has been decided to have another series in the coming session. Among the subjects upon which original communications are desired, and for which premiums arising out of special funds are offered, are :—"Mechanical Power on Tramways, including Steam, Compressed Air, Electricity, Cables, &c."; "On Electrical Conductors"; "Electro-motors—their construction, efficiency and power"; "On Gearing for Dynamo-machine Motors, and other high-speed machines"; "The Transmission and Distribution of Electricity over large areas for lighting and for motive power, including Electric Railways, Hoists, &c."; "Electrical Measuring Instruments"; "Submarine Telegraph Cables—their manufacture, laying and repair, including deep-sea sounding methods and appliances"; "Telpherage, or the Automatic Electrical Transport of Goods and Passengers"; and "The Measurement of Work by Dynamometers, with descriptions of the apparatus." At an early meeting Mr. W. H. Preece, F.R.S., M.Inst.C.E., will deal with the subject of "Electrical Conductors."

Society of Arts.—The 130th Session of the Society of Arts will commence on the 21st inst., with an opening address by Sir William Siemens, the chairman of the society's council. At the society's meeting on the 19th December, Mr. W. H. Preece, F.R.S., will read a paper on "The Progress of Electric Lighting."

Conversazione of the Society of Telegraph Engineers and Electricians.—The annual conversazione of this society was held on November 1st, at the South Kensington Museum, by permission of the Lords of the Committee of Council on Education. Mr. Willoughby Smith, the president, with whom were Col. F. Bolton, Mr. W. H. Preece, F.R.S., Mr. C. E. Spagnoletti, and the secretary of the society, Mr. F. H. Webb, received the guests. There was a large attendance of ladies and gentlemen. Amongst those present were Lord W. Seymour, Mr. Scanlan (Prime Minister of the Cape of Good Hope), the Hon. Ralph Abercrombie, Sir James Douglas, Sir Ralph Thompson, Sir T. Spencer Wells, Dr. Allchin, Mr. Fung Yee and Mr. Li-Ping Lin (of the Chinese Legation), Mr. Norman Lockyer, Sir C. H. Gregory, Mr. Michael, Q.C., Capt. Comerma (Royal Spanish Navy), Capt. Douglas Galton, C.B., Capt. Shaw, C.B., Dr. Gladstone, F.R.S., Mr. E. Graves, Prof. Hughes, and Prof. W. G. Adams. The band of the Grenadier Guards, under Mr. Dan Godfrey, played a selection of music during the evening in the Italian Court.

A New Telegraph Company.—The incorporators of the International and Northern Telegraph Company, recently organised, held their first meeting to-day in this city. The following were elected directors for the first year:—Christopher Meyer, New York; Howard Meyer, New York; Mahlon C. Martin, New Brunswick; O. G. Staples, Washington, D. C,; John F. Walton, Northern New York; N. S. Gilbert, Jefferson County; Ino F. Moffett, Watertown; Isaac Munson, Watertown; Joseph Owen, Oswego. At a subsequent meeting of directors the following officers were duly elected:—Mahlon C. Martin, president; Orren G. Staples, vice-president; Joseph Owen, secretary; John F. Moffett, treasurer. Mr. Meyer represents a large interest in railroads and steamship lines, and is identified with rubber goods manufacturing in this city and New Jersey. Mr. Gilbert is the resident manager of the Sun Fire Office, London. Mr. Staples is the new proprietor of Willard's Hotel, Washington. Isaac Munson is president of the Agricultural Insurance Company, New York. Mr. Martin, president elect, is prominently identified with manufacturing interests in New Jersey. The secretary, Mr. Owen, is well known in telegraph circles as active in such enterprises. The company, with a capital of $5,000,000, promises large additions to telegraph lines in the North and West and into Canada.—*New York Evening Post.*

The New Atlantic Cables.—The *Electrical World* of October 20th says:—"In spite of the allegation that there are already too many cables between this country and Europe, capitalists are investing their money freely in new cables that are promised to give a better and cheaper service. A number of leading business men of New York, chiefly members of the Produce, Cotton, and Stock Exchanges, have formed a company to lay cables for direct communication between New York and Liverpool at a charge about half that now exacted. Nearly all the money is assured; contracts are in negotiation for two cables of a new type, superior to any before manufactured; and guarantees against amalgamation and pooling are to be provided. The primary aim of the company is to facilitate commercial operations. The president of the new organisation is Thomas L. James, ex-Postmaster-General, and among the directors are: David H. Bingham, of David Bingham & Bros.; E. R. Livermore, of E. R. & R. B. Livermore; John H. Hebbert, of Hebbert & Allen; A. D. Straus, of A. D. Straus & Co.; John F. Plummer, of Pomeroy & Plummer; E. A. Quintard, president of the Citizens' Savings Bank; W. H. Guion, of Williams & Guion; and A. H. Rice, ex-Governor of Massachussets. Mr. J. C. Hueston, of No. 170, Broadway, will be secretary." Our contemporary then goes on to speak of the two Bennett-Mackay cables, with which subject our readers are acquainted, and pithily concludes—"Cableing will be cheap in the near future."

Proposed New Cable.—From Sophia comes the report that the Bulgarian Administration of Telegraphs is in negotiation with the Russian Government for the laying of a submarine cable between Varna and Odessa.

Overhead Wires.—Mr. A. S. Hamand, Westminster, in a letter in the *Times* of Wednesday, suggests that the wires should be carried across all thoroughfares at right angles only instead of diagonally, and supported at such an elevation that the height above the street of the points of support would always exceed the distance across the street between those points by at least 20 feet. If, then, a wire broke even close to one support the falling portion could never reach to within 20 feet of the street, but would only strike the houses. No new erections of wire should be permitted except in this way, and the present long diagonal stretches of wire should be removed at the earliest moment.

The Spanish National Company's Cables.—After having landed and buoyed the shore-end of the Cadiz-Teneriffe section of this company's cables, on the 3rd ult., the *Dacia* and *International* left Cadiz on the next day, to take soundings in the direction of the Canary Islands. The *International* arrived at Gran Canaria on the 15th October, having taken 117 soundings, and the *Dacia* arrived there on the 24th ultimo, having taken 329 soundings.

The Bennett-Mackay Cables.—We hear that the core of these cables will contain a strand of 11 copper wires of the highest conductivity, weighing 350 pounds per nautical mile, and the dielectric will consist of eight coatings of gutta percha placed upon the wire according to the improved method of Messrs. Siemens, and weighing 300 pounds per nautical mile. The deep sea portion will be covered with galvanised steel wire and Manilla hemp. All the intermediate cables are armed with steel wires. The shore ends are of the usual heavy types. The length of the entire system will be 5,600 miles.

The Brush Electric Light and Power Company of Scotland, Limited.—Before Mr. Justice Chitty, in the Chancery Division of the High Court of Justice, on Saturday, Mr. Buckley presented the petition of this company for a winding-up order. It had been found, he said, that the Scotch people were not sufficiently advanced to prefer the electric light to gas. The subscribed capital of the company amounted to £130,000, but the company had proved a failure, and had voluntarily passed resolutions to wind up. Mr. Justice Chitty: You hope to light up Scotland hereafter? Mr. Buckley: Hereafter. The application was granted.

The London and Provincial Electric Lighting and Power Generating Company, Limited.—In the Chancery Division of the High Court of Justice, on Saturday, before Mr. Justice Chitty, Mr. Ince, Q.C., applied on behalf of Mr. W. R. Cross, a creditor of this company, for a winding-up order, on the ground of an overdue bill of exchange. Mr. Whitehorne, Q.C., represented the company, and consented to the granting of the application. An order to wind up was accordingly made.

The Mediterranean Extension Telegraph Company, Limited.—The petition of Mr. Hurst for the winding-up of this company was again before Vice-Chancellor Bacon, in the Chancery Division of the High Court of Justice, on Saturday. On the 4th August, his lordship directed a meeting of the shareholders to be held, to decide whether or not they were in favour of winding up. A meeting was consequently held on the 3rd September, at which it was resolved that the company

should be wound up voluntarily. His lordship said, under those circumstances, he would make no order in addition to that of the company. Mr. Millar, Q.C., appeared for the company, Mr. Buckley in support of the petition, and Mr. Martin, Q.C., for preference shareholders.

The Gibson Underground Conduits.—We read the following in the *Philadelphia Times* of the 22nd ult.: "The 'Henry C. Gibson et al. Company' began laying underground wires yesterday on Third Street, south of Chestnut, to Walnut, down Walnut to Walnut Street Wharf. The trench contains 330 conductors on Third Street, 150 conductors on Walnut Street from Walnut Street Wharf to Sixth Street, up Sixth to Sansom Street, up Sansom to Tenth Street, up Tenth to Filbert Street and up Filbert to Fifteenth Street to Pennsylvania Railroad Station. William Wharton, jr., is the contractor for opening and closing the trench. As fast as the pipes are screwed together they are laid in the trench, which is closed and paved a few minutes afterwards." We are informed that the "Henry C. Gibson Company" holds a licence from the Brook's Company, and that the cable referred to is to be laid down on the Brook's system, that is to say, insulated with paraffin oil.

Professor Bell.—We read in an American contemporary that Professor Graham Bell has returned to Washington for the winter, and as a diversion from scientific research, and at the same time to relieve as much as possible the misfortune of his fellow-men, he has had an extensive addition made to his residence on Scott Circle, in which is a large school-room, adapted for imparting instructions after the new system of the professor himself, to deaf mutes. Mrs. Bell will assist her husband in his unselfish task of imparting a knowledge of the new mode of communicating their thoughts, and thus be the means of some good to those unfortunate like herself.

Electrical Companies' Shares.—At the Stock and Share Auction and Advance Company's sale on Thursday, the £1 shares, fully paid, of the London and Globe Telephone and Maintenance Company realised 8s. each, and the £5 shares, fully paid, of the Jablochkoff Electric Light and Power Company, 11s. 3d. each.

OFFICIAL RETURNS OF ELECTRIC COMPANIES.

Yorkshire Brush Electric Light and Power Company, Limited.—The annual return of this company, made up to the 25th ult., was filed on the 1st inst. The nominal capital is £300,000, in £2 shares. The number of shares taken up is 43,983, upon which the full amount has been called. The calls paid amount to £88,012, leaving £29 unpaid, and £75 has been paid on 150 shares forfeited. Last year the register showed that 61,633 had been taken up, but 17,500 have been returned by the Hammond Company, in accordance with an agreement of August 16th, 1883. Registered office: 326, Mansion House Chambers, 11, Queen Victoria Street.

National Company for the Distribution of Electricity by Secondary Generators.—By an agreement dated 25th of May, registered on the 2nd inst., this company will purchase from Lucien Gaulard and John Dixon Gibbs, certain patented inventions relating to the manufacture and construction of secondary generators and other apparatus in connection with electric lighting. The consideration is £220,000, payable £200,000 in fully paid-up £10 shares, and £20,000 in cash.

At an extraordinary general meeting of the shareholders of the company, held at 18, Warwick Street, Regent Street, on the 10th ult., it was resolved to divide the nominal capital of £500,000 as follows:—3,000 shares of £10 each, to bear a cumulative preferential dividend of £10 per cent. per annum, and 47,000 ordinary shares of £10 each. After the preferential dividend has been paid, the further profits will be devoted to the payment of £10 per cent. per annum on the ordinary shares, any balance remaining to be applied in payment of an equal dividend upon the shares of both classes. The resolution was confirmed at a meeting held on the 25th ult., and was duly filed on the 3rd inst.

NEW COMPANY REGISTERED.

London Electric Company, Limited. — Capital, £10,000, in £5 shares. Objects:—To carry on the business of general electrical and magnetic apparatus construction and maintenance. Signatories (with one share each):—A. Spencer, 54, Arundel Square, N.; A. J. Rhodes, Herne Bay; H. Golborne, 60, Richmond Road, W.; O. H. Fitzgerald, Teddington; E. M. Turner (electrician), 12, Rockbourne Road, Forest Hill; F. M. Brocklebank, 10, Belgrave Terrace, Lee; J. Spencer, Cookham. Registered 1st inst., without Articles of Association, by O. H. Fitzgerald, of Bushey Cottage, Teddington.

BILL OF SALE FILED.

Kent, John, 7, Benbow Road, Hammersmith, proprietor of telegraph schools, Railway Approach, London Bridge, to Henry J. Cooper. Dated October 18th; filed October 25th. £127 2s.

CITY NOTES, REPORTS, MEETINGS, &c.

The Faure Electric Accumulator Company, Limited.

An adjourned meeting of the shareholders of this company was held at the Cannon Street Hotel on Tuesday, M. E. H. Cadiot, one of the directors, presiding.

Immediately before the commencement of the proceedings the following circular was distributed among the shareholders present:—

5, Avenue de l'Opéra, Paris,
5th November, 1883.

To the Shareholders of THE FAURE ELECTRIC ACCUMULATOR COMPANY, LIMITED.

Gentlemen,—When on the 4th of October last we addressed you a circular suggesting that the meeting of the company, convened for the 15th of that month, should be adjourned until the 6th of November, it was in the confident belief that before the last-named date successful issue would have been made for the sale of the shares of the French Metropolitan General Electric Company, Limited, the outcome of our labours for some considerable time past.

Now, as you will readily understand, we have had great difficulties to contend with, and these difficulties have not been diminished by the fact that the undoubted, and now generally acknowledged, superiority of our system attracted the determined hostility of a powerful financial group in Paris, possessed of patents which would certainly have most materially increased in value were we to have disappeared or to have become powerless.

We have, however, overcome these difficulties, in proof whereof we hand you herewith a copy of the prospectus of the sale of shares of the French Metropolitan General Electric Company, Limited, which has just been advertised.

It is requisite in France that the prospectus of the sale of the shares of a company should be publicly advertised eight or ten days before the opening of the lists; and, therefore, in announcing the opening of the public subscription for the purchase of the shares of the French Metropolitan General Electric Company for the 14th inst., the least possible time is being lost.

We have sound reasons for believing that this subscription will be favourably received here. A public issue in France, conducted on the most economical principles, costs from £20,000 to £25,000, and the fact that we have readily formed a syndicate to defray the expenses of issue for the sale of the shares of the French Metropolitan General Electric Company, on most advantageous terms, proves conclusively that others believe with us in the success of the undertaking.

Should our anticipations be realised, the most material benefits will forthwith accrue to the Faure Company; but in our own interests it would, as you will readily understand, be injudicious now to enter into any detailed particulars.

In conclusion, therefore, Gentlemen, we have to propose that the meeting of to-morrow, the 6th of November, be again adjourned until Thursday, the 6th of December, by which date we confidently expect to be able to submit to you a most satisfactory statement of the affairs of our company.

The presence of your chairman in Paris is indispensable at the present juncture, and he regrets, therefore, that it will be impossible for him to address you personally to-morrow; he moreover regrets his inability to have furnished you with the present inti-

mation at an earlier date than now, but the fact that particulars connected with the prospectus of the sale of the shares were only finally settled at 12 o'clock last Saturday night, speaks for itself.

On behalf of the Board of Directors of the
FAURE ELECTRIC ACCUMULATOR COMPANY, LIMITED,
S. PHILIPPART, *Chairman*.

The Secretary (Mr. H. Canning) having read the notice convening the meeting,

The Chairman said most of them would that morning have received a circular (as above), but to any member of the company who had not he must apologise; the directors could not, however, despatch it to them earlier than they did, the board of directors in Paris having only on Saturday night as late as twelve o'clock decided to put it before them, and to give them every possible detail they could. At the same time he wished it to be distinctly understood that, though the directors agreed to issue that circular, it was most important that they should not give too many details now. The shareholders had also received notice of the issue of shares by the French Company, and that was the best proof that they were at last sailing fast to port. That they were doing so was his *bonâ fide* opinion. The issue would be before the public from that day. He had the greatest hope and faith in the success of the issuing of those shares—he would almost say from what he did know that he could hardly anticipate any difficulty in their being taken up by the public—certainly seven-eights of them would, according to his own judgment. If the French Company was successful the Faure Company would be successful. He should have a motion to put, to the effect that the meeting be adjourned for a month, but before doing so he should like to know if any shareholder had any remarks to make. He should not, however, be able perhaps, in answer to questions, to give them so full information as they might expect; it would not be to their interest if he were to say too much.

Mr. Harcourt Turner protested against the conduct of the directors. That circular was only sent out on the previous night, and they had the same old story of a directors' meeting at 12 o'clock on Saturday night. The directors were putting the shareholders off from month to month. What was the adjournment for? They had not yet passed the report and accounts presented at the meeting held on the 26th June. The directors seemed to him to be doing all they could to avoid asking them to do so, and he must protest against it.

Mr. Montague Turner: Perhaps you will explain why you have shirked asking the shareholders to pass the report and accounts.

The Chairman replied that he had explained all he could. There was not one on the board who would shirk facing the shareholders and asking them to pass the report and accounts, and when presented to them he was satisfied they would be passed. He had come there to ask them for an adjournment.

Mr. M. Turner: You ought to pass the accounts first.

The Chairman said that was a matter of opinion; he was satisfied he was doing right.

Mr. Turner considered there were two distinct things for them to do—first to have the accounts passed, and then to consider their course for the future.

The Chairman: I am asking you to wait another month.

Mr. Turner: But last month you asked us to wait another month.

The Chairman: If you had only been in my shoes during the past few weeks you would know more about it.

Mr. Turner: That is what I want to. (Laughter.)

The Chairman: Personally, I think I shall deserve your thanks later on.

Mr. Turner: I hope so.

Mr. Thomas, after alluding to the adjournments which had already been made, asked what guarantee the shareholders had that the accounts would be satisfactory to them and passed at their next meeting.

The Chairman: I am perfectly satisfied you will pass them when we meet you this day month. That is my absolute belief.

Mr. Jones said the chairman of the English Company—the Faure Company—had stated that the French Company had to pay the English Company something like £30,000 at the end of this year. Would the French Company be able to meet that liability?

The Chairman: I should say when it is due it will be paid.

Mr. Campbell said that was a payment the French Company had to make in consequence of this company putting them into funds to fulfil the obligations they had entered into. With reference to Mr. Thomas's observation in regard to accounts, the question as to whether the accounts would be passed or not was a shareholders' question. The future of the Faure Company was this,—They, as the Faure Company, were the largest shareholders in the French Company, and unless the French Company succeeded the Faure Company had no future before it. It appeared to him that the French Company were making every effort they could to put themselves in possession of funds in order that they might succeed in the great work they had undertaken on the continent. When in Paris recently he went to the offices of the French Company, and found M. Philippart hard at work in endeavouring to satisfy the French authorities as to the goodness of his accumulator—how and for what it could be used. M. Philippart explained at last meeting what he had done and what he was doing, and the future he expected for his accumulator. Since then he had been proceeding with his experiments in France, and it appeared to him M. Philippart had been perfectly successful, especially in regard to traction power. He had entered into important contracts which, if he had the means of carrying out, would make the French Company a complete and entire success, and the Faure Company would then reap a large proportion of the advantages derived. As to the accounts, of course if the shareholders did not approve of them they need not pass them, but it was no use their saying they did not approve of what the French people were doing in France at present. They were the best judges of what they ought to do to make their company a success. They appeared to be working for one object. If they got the funds they required the French Company would be a success and the Faure shareholders would reap the benefit.

Mr. Jones: But if the French Company do not succeed?

Mr. Campbell: Then the Faure Company would have very little left—it would be in the same position as many other electric companies are at present.

Mr. H. Turner: My opinion is the directors will not come forward to give us a chance of passing the accounts.

The Chairman asked why Mr. Turner took up such a hostile attitude in regard to the new board. Mr. Turner seemed to think because it was a French board the directors were bound to be dishonest.

Mr. H. Turner: Not at all.

The Chairman: Don't you think we are quite as capable of conducting the business of the company as the late board?

Mr. H. Turner: You are not showing yourselves so.

The Chairman, continuing, said they had men of business on their board, and he was perfectly sanguine of the result of their labours.

Mr. Burton thought it would be far better, instead of going into matters which might prove detrimental to the company, to agree to adjourn the meeting for another month.

Mr. Jones: Is there any explanation why only one director is present?

The Chairman: Yes, because there was no use more coming; they do not understand English. They will all come forward when the accounts are to be passed.

The Chairman moved that the meeting be adjourned till the 6th December.

Mr. Thomas seconded, and the motion was unanimously agreed to.

The meeting then separated.

The Eastern Extension Australasia and China Telegraph Company, Limited.

THE following is the report of the directors for the six months ended 30th June, to be presented at the twentieth ordinary general meeting of the company, to be held at the Cannon Street Hotel, on Wednesday:—

The gross receipts, including Government subsidies, have amounted during the half-year to £213,729 4s. 5d., against £207,119 6s. 3d. for the corresponding period of 1882. The working and other expenses (including £22,758 14s. 5d. for cost of repairs and laying of new cables and expenses of ships) absorb £62,778 11s. 7d., against £50,355 11s. 5d. for the corresponding half-year of 1882, leaving a balance of £150,950 12s. 10d. From this is deducted £1,999 10s. 9d. for income tax, and £41,595 for interest on debentures and contributions to sinking funds, leaving £107,356 2s. 1d. as the net profit for the half-year, against £113,393 3s. 10d. for the corresponding period of 1882. Of this balance, proportionate dividends on the new shares, and two quarterly interim dividends and a bonus of 1s. per share, making a total payment of 3 per cent. for the half-year, absorb the sum of £75,000, leaving £32,356 2s. 1d. to be carried forward. The calls outstanding on the new shares on the 30th June have since been paid, and from the 1st July the distinction between the two classes of shares ceased. After somewhat protracted negociations with the Chinese Government, the new China cable between Hongkong and Shanghai was opened for traffic on the 22nd May last. The Foochow station was opened on the 18th June. An interruption occurred on the Madras-Penang section, on the 6th June, near the Nicobar Islands, where so much difficulty was experienced in effecting repairs in 1876. The south-west monsoon had already set in, but the s.s. *Agnes* was fortunate enough, during a lull in the weather, to succeed in repairing the cable on the 8th July. The traffic was transmitted by the Rangoon route, and suffered but slight delay. Communication was also interrupted between Java and Australia for nine days during March, and for four days during the present month. The s.s. *Agnes* is now engaged putting both cables into thorough order, and it is expected that this will be completed in a few days. The directors have the satisfaction to report that, with the exception of the destruction of the cable house at Batavia (valued at about £100), the company's property sustained no damage from the recent terrible earthquake in the neighbourhood of Java. The land line between Port Darwin and Adelaide, belonging to the Governmant of South Australia, has been well maintained during the half-year.

The Hammond Electric Light and Power Supply Company, Limited.

AN extraordinary general meeting of this company is convened for to-day for the purpose of considering and (if then considered expedient) passing the following resolutions:—

"That it is expedient to effect an amalgamation of the Yorkshire 'Brush' Electric Light and Power Company, Limited (hereinafter called the Yorkshire Company), with the Hammond Company."

"That the agreement now submitted to this meeting, and expressed to be made between the Yorkshire Company of the one part, and the Hammond Company of the other part, be and the same is hereby approved, and that the Board of the Hammond Company be and they are hereby authorised to carry the same into effect."

"That it is expedient to effect an amalgamation of the Birmingham and Warwickshire 'Brush' Electric Light and Power Company, Limited (hereinafter called the Birmingham Company), with the Hammond Company."

"That the draft agreement now submitted to this meeting and expressed to be made between the Birmingham Company of the one part and the Hammond Company of the other part, be and the same is hereby approved, and that the board of the Hammond Company be and they are hereby authorised to enter into and carry the same into effect."

"That it is expedient to effect an amalgamation of Ferranti, Thompson & Ince, Limited (hereinafter called the Ferranti Company), with the Hammond Company."

"That the draft agreement now submitted to this meeting, and expressed to be made between the Ferranti Company of the one part and the Hammond Company of the other part, be and the same is hereby approved, and that the board of the Hammond Company be and they are hereby authorised to enter into and carry the same into effect."

"That the directors of the Hammond Company be authorised to create and issue 16,000 deferred shares of the nominal value of £5 each on the terms of the agreement already approved by the Hammond Company, and authorised to be entered into and carried into effect with the Ferranti Company."

The agreements above referred to, so far as the same relate to the Yorkshire Company, and the Birmingham Company respectively, provide for the amalgamation of the two companies, the Hammond Company foregoing their rights on the shares they hold in the Yorkshire Company and Birmingham Company respectively, and also agreeing to allot and issue to the Yorkshire Company and Birmingham Company respectively for distribution amongst its shareholders fully paid up £5 shares of the Hammond Company in the proportion of one fully paid up £5 share of the Hammond Company for every six £2 fully paid up shares in the Yorkshire Company and Birmingham Company respectively.

The agreement with the Ferranti Company will provide for the amalgamation of this company with the Hammond Company in consideration of the issue to the Ferranti Company for distribution amongst its shareholders of 7,200 ordinary shares of the Hammond Company of the nominal value of £5 each, to be issued as fully paid-up, and in consideration also of the like further issue to the Ferranti Company for distribution amongst its shareholders of 16,000 deferred shares, to be issued as fully paid up, of the nominal value of £5 each, and which will only be entitled to dividend after 5 per cent has been paid on the whole of the ordinary shares of the Hammond Company.

The Yorkshire Company, the Birmingham Company, and the Ferranti Company will, for the considerations above specified, transfer to the Hammond Company all their respective undertakings, works, property, assets, and effects whatsoever, the Hammond Company undertaking to bear and pay all liabilities and also the costs of all necessary agreements and of winding up and dissolving the Yorkshire Company, the Birmingham Company, and the Ferranti Company respectively, which windings up will be proceeded with voluntarily as soon as the amalgamations are carried out.

Western Union Telegraph Company, Limited.—The revenue for the year ended 30th June amounted to $19,454,903, and the expenses, including leased line rentals and taxes, to $11,794,553. Including $1,664,240 brought forward, the balance was $9,324,590. Of this sum the dividends to stockholders have absorbed $5,199,124, interest on bonds $416,818, and appropriations for sinking fund $40,094, leaving a surplus of $3,658,554. The total bonded debt at the close of the year amounted to $6,224,176, less $259,972, being the balance of sinking fund appropriations not yet used for redemption of bonds held by the Union Trust Company Trustees. The Court of last Resort having finally disposed of all restraints upon the company in respect to payments of dividends on any class of its capital stock, the dividend recently declared payable on and after October 15th, as also any portion of previous dividends unpaid, will be paid by the treasurer of the company on presentation of drafts of stockholders for the amounts due to them respectively.

TRAFFIC RECEIPTS.

The Cuba Submarine Telegraph Company, Limited. The number of messages passing over the lines during the month of October was 2,815, estimated to produce £2,700, against 2,172 messages, producing £1,986 in the corresponding month of last year. The receipts for the month of July, estimated at £2,760, realised £2,755.

The Direct Spanish Telegraph Company, Limited. The estimated receipts for October are £2,111, against £2,079 in the corresponding period of last year.

The Eastern Telegraph Company, Limited. The receipts for October amounted to £47,624, and to £58,175 in the corresponding period of 1882.

The Eastern Extension Australasia and China Telegraph Company, Limited. The receipts for October amounted to £26,869 and to £29,925 for the corresponding period of 1882, being an increase of £6,944.

The Great Northern Telegraph Company. The receipts in October amounted to £23,640, and from 1st January to 31st October to £215,320, as compared with £208,575 and £201,359 in the corresponding months of 1882 and 1881 respectively.

The West India and Panama Telegraph Company, Limited. The estimated receipts for the half month ended the 31st October are £2,246, as compared with £1,646 in the corresponding period of 1882.

LATEST QUOTATIONS.

Authorised Issue.	Shars.	Name.	Paid.	Closing Quotations Nov. 7.	Business Done.
		ELECTRIC LIGHT.			
40,000	10	Anglo-American Brush Co.	8	2½ - 3	
		Do. Do.	10	4½ - 5½	
30,000	5	Australasian E. L., Power & Storage Co.	5	¾ - 1	
24,900	10	British Insulite Co., Ld., "A" Shares	5	1 - 2	
30,000	5	Brush Elec. Lt. & Power Co. (Scotland)	2½	¾ - 1	
25,000	5	Gt. Western Electric Light & Power Co.	2½	¾ - 1	
24,980	5	Hammond Elec. Lt. & Power Sply. Co.	3½	3½ - 3¾	
40,000	5	Indian & Ori. Electl. Storage Wks. Co.	2	..	
197,500	1	Maxim-Weston Elec. Lt. & Power Co.	1	½ - ¾	
..	..	Metrop. Brush Electric Lt. & Power Co.	3	..	
40,000	5	Pilsen-Joel & Gen. Elec. Lt. Co.	2½	..	
..	..	S. African Brush Elec. Lt. & Power Co.	2½	..	
100,000	5	Swan United Electric Light Co., Ld.	2½	½ - 1¼	
		TELEGRAPHS.			
2,116,400*l.*	Stk.	Anglo-American, Limited	100	44 - 45	
2,441,800*l.*	Stk.	Do. Pref. } Def. receiving no div. until	100	74 - 75	74½.
2,441,800*l.*	Stk.	Do. Def. } 6 p. c. paid to Pref.	100	14½ - 15½	14⅝.
150,000	10	Brazilian Submarine, Limited	10	9½ - 9¾	9⅝-9¾-9⅝.
16,000	10	Cuba, Limited	10	10½ - 11	
6,000	10	Do. 10 per cent. Preference	10	17 - 18	
13,000	10	Direct Spanish, Limited	9	5½ - 5¾	
6,000	10	Do. 10 per cent. Preference	10	15½ - 15¾	
65,000	20	Direct United States Cable, Ld., 1877	20	10¾ - 10¼	11 10¼-xd.
100,000*l.*	100	Do. 6 per cent. Deb., repayable 1884	100	98 -101	
380,000	10	Eastern, Limited	10	10¾ - 11	11-10¾.
70,000	10	Do. 6 per cent. Preference	10	13 - 13½	13⅜.
232,000*l.*	100	Do. 6 do. Debs., repayable Oct. 1885	100	..	
200,000*l.*	100	Do. 5 do. do. Aug. 1887	100	102-104	103.
200,000*l.*	100	Do. 5 do. do. Aug. 1899	100	104-108	
199,750	10	Eastern Exten., Australasia & China, L.	10	11¼ - 11½	11⅛-11⅜-¼.
320,000	100	Do. 6 p. c. Debs., repayable Feb. 1891	100	107 - 110	108.
500,000	100	Do. 5 p. c. (Aus. Gov. Sub.) Deb. 1900	100	102 - 106	
140,000	100	Do. do. reg., repayable 1900	100	103 - 107	
100,000*l.*	100	Do. 5 per cent. Debenture, 1890	100	101 - 104	xd.
254,300*l.*	100	Eastern & South African, Ld., 5 p. c. Mort. Deb. Rg. redeemable 1 Jan. 1900	100	102 - 105	
345,700*l.*	100	Do. do. do. To Bearer.	100	102 - 105	
22,050	10	German Union Telegraph & Trust, Ld.	10	10 - 10¼	7/16-7/8-7.
163,390	10	Globe Telegraph & Trust, Ld.	10	7 - 7¼	7/16-7/8-7.
163,209	10	Do. 6 per cent. Preference	10	12¾ - 13¼	13/16-13.
125,000	10	Great Northern	10	12¾ - 13¼	
100,000*l.*	100	Do. 5 per cent. Debentures	100	100 -103	
300,000	100	Do. 5 per cent. Debentures	100	101 -103	
31,200	10	India-Rubber, Gutta-Percha, & Tel. Wks.	10	30 - 31	
100,000	100	Do. 6 per cent. Debs., 1888	100	102 -103	
17,000	25	Indo-European, Limited	25	31 - 32	xd.
38,148	10	London Platino-Brazilian, Limited	10	3½ - 4	
12,000	10	Mediterranean Extension, Limited	10	1¼ - 1½	
8,200	10	Do. 8 per cent. Preference	10	2 - 4	
9,000	8	Reuter's, Limited	8	8½ - 9	
280,000	Stk.	Submarine	100	190 -200	
58,225	1	Do. Scrip	1	1¼ - 2¼	
4,200	Cert.	Submarine Cables Trust	100	102 -103	103½.
37,350	12	Telegraph Construction and Mainten.	12	36 - 37	36¾-¼.
150,000	100	Do. 6 per cent. Bonds, 1884	100	101 -103	
186,750	5	Do. 2nd Bonus Trust Cert.	2½	1½ - 1¾	xd.
30,000	10	West Coast of America, Limited	10	5 - 5½	
150,000	100	Do. 8 per cent. Debs.	100	106 -108	
69,910	20	Western and Brazilian, Limited	15	4½ - 5½	
		Do. Preferred	7½	4 - 4½	
		Do. Deferred	7½	½ - 1	
200,000*l.*	100	Do. 6 p. c. Debs. "A" 1910	100	102 -106	
2,500	100	Do. 6 p. c. Mort. Deb. B. '80, red. Feb. 1910	100	94 - 97	
1,500	$1,000	Western Union 7 p. c. 1 Mort. (Bg.) Bds.	$1,000	119 -121	xd.
1,030,000*l.*	100	Do. 6 per cent. Sterling Bonds	100	100 -103	
88,321	10	West India and Panama, Limited	10	1 - 1½	
34,563	10	Do. 6 per cent. 1st Preference	10	7 - 7½	
4,669	10	Do. 6 do. 2nd do.	10	4½ - 5	
		TELEPHONES.			
154,165	1	Con. Tele. & Mainten., L., Nos. to 154,165	1	¼ - ⅜	⅜.
200,000	1	Oriental Tele. Co., Nos. 80,001 to 300,000	¼	¼ - ⅜	
100,000	5	United Telephone Co.	5	8 - 8½	8½-½.

NEW PATENTS—1883.

5177. "Construction of armatures for electrical apparatus." F. C. GLASER. (Communicated by Messrs. Kuksz, Luedtke and Grether and A. J. Gravier.) Dated October 31.

5180. "An improved electric burglar or fire alarm and signal connected therewith." F. J. HARRISON. Dated October 31.

5195. "Manufacture of porous pots and porous plates for galvanic batteries." T. COAD. Dated November 1.

5198. "Electric telephone transmitting and receiving instruments." A. F. ST. GEORGE. Dated November 1

5201. "Telephone transmitters." G. L. ANDERS. Dated November 1.

5202. "Electric meters." R. BELFIELD. Dated November 1.

5210. "Electro-magnetic machines." N. ROLLAND and H. B. FORD. Dated November 2.

5238. "Electric generators." H. J. HADDAN. (Communicated by the Bain Electric Company.) Dated November 5.

5251. "Receiving instrument of speaking telephones." H. J. ALLISON. (Communicated by J. H. Robertson.) Dated November 6.

5252. "Electric Lamps." H. J. HADDAN. (Communicated by F. H. Werner and L. Ochse.) Dated November 6.

5263. "Galvanic batteries." C. D. ABEL. (Communicated by G. Przibram, H. Scholz and W. Wenzel.) Dated November 6.

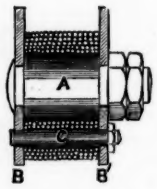
ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1883.

24. "Generation, storage, distribution, regulation, measurement, and utilisation of electricity, &c." J. S. WILLIAMS. Dated January 1. 3s. 10d. Consists in improvements in and relating to the generation, storage, distribution, regulation, measurement, and utilisation of electricity, and apparatus or means therefor, and in methods or means to be employed in the construction of such apparatus or parts thereof. (Too lengthy for abstract.)

804. "Construction of dynamo-electric machines, &c." H. T. BARNETT. Dated Feb. 14. The object of these improvements are the construction of a powerful and compact dynamo-electric machine, and the suppression of the "Foucault" or induced currents in the cores of the armatures and field magnets of such machines, and in the cores of electro-magnets, induction coils and similar apparatus. In constructing the armature the inventor winds the coils of wire or other conductor upon a false bobbin or reel, having one or both discs or cheeks removable. One or both of the cheeks of the false bobbins have holes or slots formed through or in them at a convenient distance from the centre, so that a rod may be passed through parallel with the core. He

FIG. 1

FIG. 2



first winds on the false core one or more layers of wire, then inserts the rod and continues the winding to completion. The coil may then or subsequently be saturated with cement or bound with wire or thread to strengthen it and hold the helix together. The coil being wound is removed from the false bobbin, and the rod is withdrawn, when two holes will be found through it, one produced by the false core in the centre and another formed by the rod. The hole for the core may then be filled by a special core, or in some cases the core may be omitted. Figs. 1 and 2 illustrate the shape of the coils and the method of forming the same, fig. 1 being a cross section and fig. 2 an axial section of a false bobbin wound with wire. A is the false core, B a fixed and B^1 a removable flange, and C the removable rod.

867. "Apparatus for generating and utilising electricity." F. M. NEWTON. Dated February 16. 6d. Has for object improvements in apparatus for generating and utilising electricity.

965. "Apparatus for transmitting audible signals by electricity." A. F. ST. GEORGE. Dated February 21. 8d. Relates to the apparatus described in the number of the JOURNAL for October 19th.

973. "Dynamo-electric machines." J. HOPKINSON. Dated February 22. The object of the invention is to obtain greater

FIG. 1

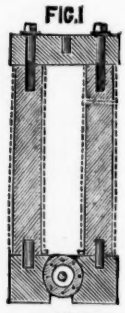


FIG. 3

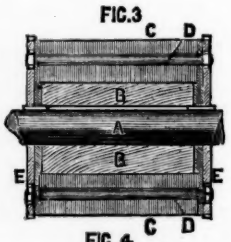


FIG. 2

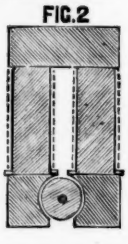
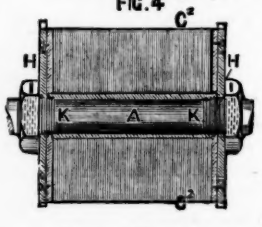


FIG. 4



effect from existing dynamo machines without increase of size and weight of the machine, or to obtain as great an effect from a machine of a small size as has hitherto been obtained from machines of a larger size. The improvements are applicable to dynamo machines having armatures of the form known as the Siemens' armature, and specially to the improved form known as the Edison machine, and may be used whether the machines are for producing electric currents or for motors. The improvements consist, first, in increasing the sectional area of the exciting magnets and diminishing their length. Fig. 1 represents the proportions of an ordinary machine known as an "Edison dynamo," and fig. 2 a machine constructed in accordance with the invention, from which it will be seen that the sectional area of the cores of the magnet does not differ greatly from the whole area of a cross section of the armature through the axis, and that the length of the said cores is about two and a half times the diameter of the armature; but the inventor does not limit himself to the exact proportions shown. The invention also consists in an improvement in the armature, which is shown by figs. 3 and 4, of which fig. 3 represents a longitudinal section of the ordinary armature of what is known as an "Edison dynamo," A being the shaft, B the lignum vitæ sleeve, C the iron and paper discs, D the fastening bolts and nuts, and E the insulating and binding washers. It will be observed that the sectional area of the core of the armature shown in fig. 3 is diminished both by the bolt holes for the bolts, D, and the hole through the centre for the lignum vitæ bush and the shaft. In the improved armature as shown in fig. 4, these losses are avoided, and the sectional area of the armature is increased. The hole through the centre is diminished in diameter, and the bolts, D, shown in fig. 3, are omitted, and consequently the bolt holes are unnecessary. The discs, C^2, are clamped together by means of the washers, H, and the nuts, I, running upon screws, K, cut upon the shaft, A, of the machine. The discs are in all cases properly insulated from each other, and the iron parts of the body by fibre, ebonite, or other insulating material.

1014. "Tramways and apparatus for propelling tramcars by electric or steam engines." M. H. SMITH. Dated February 24. 1s. 2d. Is mainly designed for propelling electric tramcars, and relates to improved apparatus for collecting and transmitting the power from the conducting bands to the electric motor.

1016. "Electric secondary or storage batteries." R. H. COURTENAY. Dated Feb. 24. 2d. The object of the first part of the said invention is to prevent or lessen the leakage of the electric current in electric secondary or storage batteries when such batteries are charged and not in actual use. The object of the second part of the said invention is to improve the condition of secondary or storage battery cells, that is to render them more suitable for receiving an electrical charge. (*Provisional only*).

1019. "Operation of electrical generators by gas engines." T. J. HANDFORD. (Communicated from abroad by T. A. Edison, of America.) Dated February 24. 6d. Consists in employing in connection with a gas engine, and the generator or generators driven thereby, means operated automatically by the movement of the apparatus, to compensate for the increase of speed, by reducing the proportion of the entire current generated, which is transmitted to the translating devices.

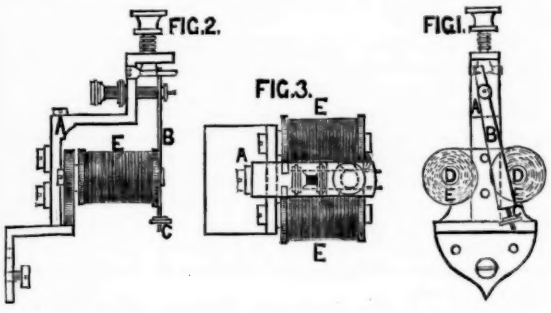
1022. "Construction of electrical railways." T. J. HANDFORD. (Communicated from abroad by T. A. Edison, of America). Dated Feb. 24. 6d. Consists in providing each line of rails used as a conductor, with two or more continuous conducting wires, on one or on each side of the line of rails, which continuous wires pass beneath the fish-plates at the joints of the rails, and are clamped by such fish-plates against the rails. These wires may be bare copper wires or they can be insulated between the fish-plates, and left bare where they pass under such fish-plates, the object being to bridge over the joints more perfectly than has hitherto been the case.

1037. "Generating electricity." A. M. CLARK. (Communicated from abroad by H. A. Archereau, of Paris.) Dated February 26. 4d. Relates to a method of generating electricity, consisting in the employment of bodies into whose mutual reactions enters only oxygen taken by one of them from the atmospheric air, which oxygen is restored when expended, so that the operation is continuous, and consists, shortly, in fixing the oxygen of the air in a substance susceptible of forming a liquid combination, and then expending this oxygen to produce electricity by the oxidation of a suitable substance (generally carbon), and lastly re-oxidising by the oxygen of the air the substance which serves as the vehicle, and so on repeatedly.

1043. "Treatment of metallic ores by the combined action of electricity and water." W. J. TANNER. Dated February 27. 6d. Relates to an improved method of treating metallic ores, with the object of effecting wholly or partially the required disintegration of the substances treated, by the combined action of electricity and water, and to apparatus employed for that purpose.

1059. "Telephonic apparatus, &c." L. J. CROSSLEY and W. EMMOTT. Dated February 27. 6d. Relates to a new form of electrical indicator or relay, specially adapted for use in telephone exchanges, but which is applicable also to other purposes. In the working of telephone exchanges it is found that considerable delay is caused where the subscribers have not some means independent of the calling signal of indicating in the exchange that the lines are at liberty and may be put back ready for the next call. To overcome this defect the inventors have arranged an indicator or relay having a swinging needle or needles, which can, if desired, be adjusted by a weight, magnet, spring, or by any other suitable means, near the pole or poles of an electro-magnet in such manner that the rapidly alternating currents of electricity generated by a double current magneto-generator, now so largely

in use, will not deflect the needle definitely in either direction, but on a current in one direction alone being sent the needle will be deflected so as to close a local circuit and drop a mechanical indicator or other suitable means to attract the operator's attention. The needle may also be so arranged as to remain in the deflected position until put back by the operator. In addition to its use in telephone work, this indicator may be used in block signalling instruments, light indicators, and signal indicators, together with other electrical signalling instruments on railways, and also at intermediate telegraph or telephone stations where it is desired to avoid switching. The indicators may also be usefully applied to other purposes. Fig. 1 represents a front view of the indicator or relay; fig. 2 is a side view, and fig. 3 a plan of the same. A is



the indicator or relay constructed with the swinging needle, B (or needles), which can be adjusted by the weight, C, or by a magnet, spring, or other suitable means, near the pole or poles, D, of an electro-magnet, E, in such a manner that the rapidly alternating currents of electricity generated by a double current magneto-generator, such as those now so largely in use, will not deflect the needle, B, permanently in either direction; but on a current or series of currents in one direction alone being sent, the needle, B, will be deflected so as to close a local circuit or drop a mechanical indicator, or otherwise attract the operator's attention. The needle, B, may also be so arranged as to remain in the deflected position until put back by the operator by allowing the needle, B, to come into contact with either of the poles, D.

1079. "Mechanical telephone apparatus." H. J. ALLISON. (Communicated from abroad by G. F. Shaver, of America.) Dated February 28. 6d. Relates to a mechanical or acoustic telephone exchange, and chiefly consists: First. In the mode of and means for supporting and maintaining the tension of line wires. Second. In the mode of and means for connecting and tightening line wires. Third. In the manner of constructing and supporting the telephone; and Fourth. In the construction and arrangement of other parts of the central office apparatus.

1093. "Preparing insulated wires." H. E. NEWTON. (Communicated from abroad by A. A. Cowles, of America.) Dated February 28. 6d. The object of this invention is to produce insulated wires suitable for electric conductors capable of resisting both fire and moisture. To this end the bare wire is first covered with a fibrous coating, by preference such as may be applied by the well-known braiding machine. The coated wire is then led through a funnel supplied with an oil paint consisting preferably of white lead or zinc mixed with boiled linseed oil. While this coating of paint is still wet, a second coating of fibres by the braiding machine is applied; the wire is then passed under the pressure of grooved rollers which consolidate the coatings by causing the wet paint to be absorbed into the two fibrous coatings. The wire is next led through a funnel supplied with fluid asphalte, India-rubber or japan varnish, and as it leaves this funnel coated with the varnish, it is led away to a reel upon which it is wound. The travel of the wire during this process is facilitated by means of guide rollers. When the reel is filled, the coated wire is removed therefrom in its coiled state and dried, after which it will be fit for the market.

1113. "Electric generators." R. D. BOWMAN, J. E. L. CLARK, and W. J. K. CLARK. Dated March 1. 6d. Relates, firstly, to improvements in the construction of the armatures of electric generators, the object being to increase their efficiency and enable them to be easily and conveniently put together or taken to pieces as required. Relates, secondly, to the construction of the field-magnets with the view of increasing their efficiency and ensuring the passage of the lines of force in a direction in which they can be utilised, thereby strengthening the magnetic field.

1115. "Telephonic apparatus." A. R. BENNETT. Dated March 1. 4d. The first part of the invention has reference to the translation of telephonic impulses between ordinary single wires joined to earth at their extremities, and double wires or metallic circuits of which the earth forms no part, and is a development of the invention described in the specification of the inventor's Patent No. 4,428 of 1881. When induction coils are used for this purpose in the manner fully set forth and described in the specification of the Patent No. 4,428 of 1881, the inventor finds it advantageous to wind the coils with a third or tertiary wire, superimposed upon the primary and secondary wires, and to join the ends of this tertiary wire, either directly together, or through a wire or conductor possessing electrical resistance. Or they may be joined to earth either directly or through resistance. Instead of being wound upon a soft iron core, as set forth in the specification of the aforesaid Patent, No. 4,428 of 1881, the primary and secondary wires, upon which may be superimposed a tertiary wire, may be wound upon one end or pole of a steel permanent magnet, or upon one end or pole of an electro-magnet. Another method of translating telephonic impulses between single wires and metallic circuits, consists of a combination of a receiving telephone, which may be either of the Bell or of the Edison type, with a Blake transmitter, or any other transmitter to which the sound waves which it transforms into electrical impulses, are conveyed through the medium of a disc or diaphragm. To the vibrating disc of such a receiving telephone, the inventor attaches directly the mechanism of the transmitter, in such a manner that the vibrations of the receiving disc set up by the passage of electrical impulses through the coils of the receiving telephone are imparted to the transmitter and by it re-converted into electrical impulses. The receiving telephone being in circuit with one wire, and the transmitter with a second, the impulses will clearly be translated or communicated from the first to the second wire. For translation in both directions each wire must be furnished with a receiving telephone, having attached to its disc a transmitter which is in circuit with the other. Another plan of accomplishing the same object consists in the use of electrical condensers having three, four, or more plates instead of the two with which such condensers have been invariably furnished. By one modification of this plan, the end of the single wire and earth are connected to one pair of plates, and the ends of the metallic circuit to another pair. Any of these methods are adapted for translation between two single wires, or between two metallic circuits, as well as between a single wire and a metallic circuit. The second part of the invention relates to the transmission of telephonic impulses over long lengths of wire. As is well known, the effects of the phenomenon termed electro-static induction has heretofore limited the successful application of the telephone to lengths of about 200 miles of aërial wire, and to much shorter lengths of buried or submerged wire. To overcome the deleterious effects of electro-static induction, the inventor divides the long line over which it is desired to transmit telephonic impulses into convenient sections, all of which must be short enough to be spoken over with ease by means of ordinary instruments. At the termination of each section is placed translating apparatus, which may be of any of the types described in the specification of the Patent No. 4,428 of 1881, and in the present Provisional Specification, or of any other efficient type. The long line being divided into sections having no direct or metallic connection with each other, the total amount of retardation or interference due to electro-static induction on the whole, will be only that proper to the longest section. The third part of the invention relates to the destruction or modification of the effects upon a single telephonic wire of electro-dynamic induction from neighbouring or parallel telegraphic or telephonic wires. The destruction or modification of such effects may be accomplished, according to the invention, in three ways:—Firstly, by the insertion of ordinary induction coils in circuit with the line at each end thereof, such induction coils to have primary wires of very small resistance, and secondary wires of larger resistance. The coils may have iron cores, or no cores at all. The primary wires of the coils should preferably be in circuit with the line, while the receiving telephones are attached by their connecting wires to the secondaries, but this arrangement may be reversed. Secondly, by the insertion in circuit with the line at each end thereof of electrical two-plate condensers of the ordinary construction, of such small capacity that the disturbing effects in the telephones of the electro-dynamic induction from other lines are either entirely destroyed or greatly modified by being forced to pass through them. Thirdly, by the use of shunts or derived circuits at both ends of the line, arranged so as to divert a portion of the received currents to earth before reaching the receiving telephones, or to prevent a portion of the received currents passing through the telephone by means of a loop of wire possessing some electrical resistance between its terminals.

1121. "Obtaining materials and elements to be used in constructing and working primary voltaic batteries." D. G. FITZ-GERALD and T. J. JONES. Dated March 1. 4d. Relates to the production of peroxide of lead by the conversion of an oxide or an insoluble salt of lead which may be in admixture with pyrolusite or other oxide of manganese into peroxide of lead or to the production of other oxidising materials, such as chromic acid, and to the simultaneous reduction of certain metals.

1983. "Manufacture of subterranean electric cables." H. J. ALLISON. (A communication from abroad by S. F. Shelbourne, of America.) Dated April 19. 6d. Consists—Firstly. In the employment of annular notched templates within the cable to secure uniform distances between the wires. Secondly. In the relative disposition of these templates, in the notches of which the wires are placed, so that the wires of one series are made to cross the wires of the adjacent series, and the insulating material is continued in nearly equal bulk longitudinally. Thirdly. In the arrangement and connection of the wires with reference to the direction of their spirals and parallelism in the succeeding divisions of the cable. Fourthly. In the combination of said spiral cable conduction wires with an insulated metal spiral conductor for a distance ground connection or a return conductor. Fifthly. In the sectional moulds by which the insulating substance is confined, so as to enclose and protect from air and moisture the wires of the cable. And sixthly. In an insulating composition which leaves the cable moderately flexible, and permits the wires to expand or contract without injury to the wires or the insulation.

CORRESPONDENCE.

Overhead Wires.

In the article in your issue of October 27th, on the subject of overhead wires, I notice you mention that the public are quite able to look after their own interest. I might add to this, so are lawyers, in proof of which I send you a copy of an account presented by a well known firm of solicitors to a telegraph company with which I am connected.

A short time ago, the telegraph company in question applied to one of our public companies for permission to be allowed to make an attachment for a single wire to the chimney stack of their building. This permission was readily granted at a nominal rental of 4s. a year, and an agreement was drawn up accordingly at their request, and sent for signature. The agreement was duly returned, signed, and the wire erected. So far so good, but imagine the amazement of the telegraph company upon receipt, some weeks afterwards, of the solicitor's charges, of which of course they were entirely ignorant, and I need not state that had they been aware of such a claim being made they would very carefully have avoided the unfortunate chimney stack.

Lineman.

Messrs. . . . . & Co.'s Charges in the matter of the . . . . . and . . . . . Telegraph Company.

1883.	£	s.	d.
Attending superintending committee on an application from the . . . . . Telegraph Company to erect a wire on the building and advising thereon	0	10	0
Attending Mr. . . . . on the proposed agreement and taking his instructions, and we were to communicate with the architect ...	0	10	0
Instructions for agreement	0	6	8
Drawing agreement and copy for architect...	1	0	0
Attending Mr. . . . . on draft agreement and going through same with him, and making additions thereto	0	10	0
Making copy proposed agreement for the superintending committee	0	3	4
Attending superintending committee, reading over draft agreement, and taking their instructions as to certain alterations to be made therein	0	10	0
Perusing and altering agreement accordingly	0	3	4
Making copy agreement for Mr. . . . . as altered	0	3	4
Writing Mr. . . . . with altered draft ...	0	3	6
Writing Secretary . . . . . Telegraph Company, with draft agreement received from Mr. . . . . approved	0	3	6
Engrossing agreement in duplicate	0	13	4
Attending solicitor of company with one part of agreement, and draft for examination and execution and letter	0	10	0
Attending Mr. . . . . reading over agreement and obtaining his signature thereto ...	0	13	4
Attending stamping	0	6	8
Paid stamp duty	0	1	0
Attending examining and exchanging agreements	0	10	0
Attending Mr. . . . . with agreement executed and letter	0	10	0
Letters, postages, &c.	0	5	0
	£7	13	0

Atlantic Cables.

Your leader in the REVIEW of the 22nd September last has revived an interest in Atlantic telegraphy which had too long lain dormant, and has produced a discussion which will in the end, I think, prove beneficial to those who may have to communicate by telegraph between Europe and North America, inasmuch as it brings forward in a prominent manner the question of a reduction of the 2s. tariff rate, and further (in your last issue), the extract from the Paris *Figaro* presents to our notice the advantages of a new route.

You began by asking, "Will Atlantic traffic support two new cables," and you went on to prove this, assuming the two new cables to be laid on parallel lines with the present cables between England and Nova Scotia, and putting the cost of each cable by competition at £600,000.

Taking advantage of the route offered by M. de Braam in the Paris *Figaro*, I will endeavour to supplement your argument, and show how, by a reduction of capital, two new Atlantic cables can pay even at reduced rates.

In the following comparison of cost, I take the type of cable to be the same as now used, and of the same carrying capacity in both cases.

The route between England and Nova Scotia in one span, going south of the Newfoundland Banks, with a proper percentage of slack, will require 2,650 miles of cable, the cost of which you place at £600,000.

By the route *viâ* the Azores, which goes a little further south than the preceding, and landing at Flores, the most westerly island of the Azores group, the line is divided into two spans of 1,470 and 1,511 miles of cable respectively.

The longest length on the two-span route is 1,500 miles, as against 2,600 miles on the one-span route—a difference of 1,100 miles.

Taking the working speed through each of the above routes at 12 words per minute (without duplexing), there will be a saving by the two-span route of £150,000, at least, in the copper wire and gutta-percha alone; to this must be added a further large sum in the steel wire and hemp yarn, also in expenses of shipping and risks of laying. It may, therefore, be safely stated that 40 per cent. in first cost might be saved in a cable between England and the continent of America by adopting the Azores route, whilst the amount to put by annually to the renewal fund would be of course proportionately reduced.

The soundings on Admiralty charts along the Azores route give the ground at the bottom of the ocean to be far more favourable as a bed for a cable than the irregular ground shown by the soundings where the present cables are laid; there can, therefore, be no valid objection raised to the Azores route on this point.

The cost of cables over the two routes will compare thus:—

Two lines of cable over the one-span route, at £600,000 each	£1,200,000
Two lines of cable over the two-span route, at £360,000 each	720,000
Difference	£480,000

I have next to compare the amount to be annually set aside for the renewal fund.

The Anglo-American Company own four cables across the Atlantic, valued by you at £850,000 each; they put by annually £150,000 to the renewal fund, or 17·7 per cent. of the value of one section only.

The one-span route between England and Nova Scotia is taken to cost £600,000, 17·7 per cent. of which to put by annually to the renewal fund amounts to	£106,200
The two-span route *viâ* the Azores will average £180,000 a section, 17·7 per cent. of which to put by annually to the renewal fund amounts to	31,860
Difference	£74,340

With £480,000 less capital, and £74,000 less to put by annually to the reserve fund, there cannot be a doubt about the Azores route being the most economical for a cable between England and North America, and the only one, upon a reduction of the tariff rate to 1s. per word, which would pay the shareholders a fair and reasonable dividend upon their capital.

It is further stated in the *Figaro* that M. de Braam holds an exclusive right for 20 years of landing cables

at the Azores. Such being the case, the proprietors of the Azores route need not fear competition from those lines of longer length, and costing nearly as much again.

Mr. Weaver says: "The question investors and the public desire to see answered is, 'Will Atlantic traffic support two new cables at an uniform tariff of 1s. per word?'" A satisfactory answer to this question may be found in the particulars of the Azores route as given above.

A. O.

Electric Lighting in the City.

Referring to the announcement in your last issue as to the result of the Gülcher and Edison Tenders for the City lighting, I, for one, should be glad to understand the basis of the charge for electricity named as 8½d. Do I understand that this charge includes renewals of lamps when these give out, or the filaments are broken, as this does not appear to be clear in the notice which I refer to.

Apologising for taking up your space.

Enquirer.

London, E.C., *November 1st*, 1883.

[Perhaps the representatives of one of these companies will reply to our correspondent's query.—EDS. ELEC. REV.]

Philipp Reis.

I must ask your indulgence if I occupy a considerable space in your columns this week.

You have done me the honour to insert in your issue of the 2nd inst., extracts from two articles published in America relating to my recently-published work on Philipp Reis, the inventor of the telephone. One of these articles is a very straightforward letter from Mr. E. Berliner, between whom and myself there has been some correspondence in the *Electrical World*, published in New York. I beg herewith to hand you a copy of my reply to Mr. Berliner, with the request that you will do me the favour to publish it in full. I have been desirous to give Mr. Berliner every opportunity of raising such points as he may see fit, and to give him every possible assistance in understanding that which Reis said and did, because of the fair and open manner in which, where he has differed in opinion from me, he has stated that difference of opinion. For example, I may refer to that portion of his letter, as reprinted by you on page 323, in which he propounds a view of his own as to the way in which Reis proposed "to do what we are doing to-day—produce electrical undulations." These words—Mr. Berliner's own—show that he is as anxious as I am to understand not only what Reis intended to do, but also what Reis did, and how he did it. My reply to the issues raised by Mr. Berliner is written, I trust, with the patience that such a subject demands.

The other article from which you have given extracts is one which under ordinary circumstances would have been treated with the silence that articles of this stamp usually receive. It appeared originally in a paper published in America, on the cover of which appear the words "An Illustrated Journal, published weekly." "Owned by the —— Company." The names of the directors of the company are given. I perceive that of Gardiner G. Hubbard amongst the directors. It is almost needless to add that the article in the company's paper was anonymous. Need I say more to justify me in declining to take any notice whatsoever of certain scurrilous personal reflections therein contained.

Nor should I have stirred a hair's-breadth to reply to any of the arguments on the scientific points raised therein had not your editorial pen seen fit, in admitting certain extracts to your pages, to add that some of their views fell in with the views which, in reviewing my book, you were pleased to express a little time ago. It is on that account, and that account only, that I revert to any of these extracts.

In examining the various forms of Reis's apparatus as described in pages 14 to 29 of my book, I observed the contact-points to be in some cases mounted on springs, precisely as are the contacts in some of Edison's and Blake's transmitters. I propounded my opinion in an appendix, pages 135 to 141, that these springs were introduced by Reis for the very same purpose as that for which they were used by Edison and by Blake, namely, to produce a "following-contact," so that the interruption of the current might not be abrupt, but gradual and in correspondence with the vibrations. My opinion, and it was only propounded as my opinion, was based, firstly, on the observation that the springs did so act both in Edison transmitters and in Reis transmitters, and, secondly, on the agreement between this suggestion and the language used by Reis himself as to the necessity of a perfect *correspondence* between the oscillations of the tympanum and those of the contact-parts of the interruptor. My opinion is controverted by the anonymous writer, who does not deny that Reis used springs and adjusting screws, or that Edison used springs and adjusting screws, or that Reis's springs are uncommonly like Edison's and Blake's. He contends that these springs, though used in Edison's and Blake's instruments to prevent abrupt makes-and-breaks of the current, were used in Reis's instrument to promote them. This very singular argument is further supported by the statement that in the first transmitter of Reis (shaped like a human ear) the screw pressed the spring *away* from the membrane whilst the spring itself pressed toward the membrane, and therefore was designed to ensure a total break of contact when the membrane receded. Please note the alleged *design* and the attitude of the screw. Now it so happens that in a later form of transmitter devised by Reis—namely, the lever-form (page 25 of my book)—in which the contacts are arranged in an identical manner, the screw is reversed, and presses the spring *towards* the tympanum. If the anonymous one is right in his view of the design and attitude of the screw in the first instance, there can be no doubt that in the second instance the spring *was* "designed" to prevent an abrupt break. But the anonymous one does not seem to have noticed this, or he would not have given me so useful a confirmation of my opinion that Reis used springs for the very same purpose as the later inventors did.

The anonymous writer further says, in the most confident way, that "Reis did not know, and could not know, that the strength of a current could be controlled by the varying pressure of the conducting surfaces between which it passes." Could he not? It so happens that this was part of the common stock of knowledge, at least *in Europe*, at that time. I do not know whether it was known in the States. But it stands written, if I am not mistaken, in an early volume of Count du Moncel's well-known treatise, published years before, that the current in interruptors (yes, he used the very name that Reis used), consisting of metallic surfaces in contact, was altered by pressure. I have not the book before me, but the passage is easily found.

As to the functions of the calling apparatus attached to the side of some of Reis's transmitters, the eagerness of the anonymous one to invent a flaw in my proof of the use of this apparatus, shows me how well I have succeeded in proving my point. I need only refer any inquirer to my book, p. 99, where Prof. Pisko, in 1865, describes such an apparatus as one which would "give signals to great distances that somebody is speaking"—through the telephone, and he suggests that an electric bell might do instead.

The anonymous writer says that 1852 is a misprint for 1862 as the date of Reis's invention. But Reis himself in 1861 says that his first attempt was made nine years before—therefore in 1852.

The anonymous one further quotes from a little book of mine a passage written in the spring of 1881 relating to one form of Reis's instruments. It is quite true that at that time I did not understand the action of that instrument fully. Nor did Sir William Thomson,

if the passage attributed to him be really his. I have several times, I fear, failed to do justice to Reis. At that time I did not even know that the lever-form of instrument, and its electro-magnetic receiver, which I was familiar with from the description of them in "Kuhn's Handbook," were really Reis's. I imagined them to be Von Legat's improvement of Reis; and I knew that this form of instrument not only comprised an electro-magnetic receiver and a transmitter with springs, but that they were described in "Kuhn's Handbook" as having transmitted speech to a certain extent. I did Reis the injustice of being ignorant that this exquisite apparatus was his work. I have sought to make amends for my unintentional injustice by helping to let others know: *firstly*, what Reis intended to do; *secondly*, what he did do. My work, such as it is, is now before the world. I have nothing to gain by making Reis's invention appear either better or worse than it was. Reis invented an imperfect telephone. He never said it was perfect. Nor have I so said. Reis said he intended it to transmit speech. No one now denies that. Reis said that he had succeeded up to a certain degree in reproducing the human voice (ja bis zu einem gewissen Grade die menschliche Stimme zu reproduciren). No one dare deny this, unless he is prepared to deny everything that he does not like to believe. Reis said he had a difficulty in transmitting the vowels. I do not think any person doubts the truth and candour of his admission. Reis said he looked forward to the time when "mechanical science" should perfect the imperfections of his apparatus. The fact that I, amongst others, have, while studying these splendid but neglected researches, found certain means of applying mechanical science to correct some of those acknowledged imperfections, and have taken steps to secure my right to use the improvements I have made, does not in the smallest degree affect the facts about Reis or what he attempted. I have nothing, I repeat, to gain by making Reis's invention appear better or worse than it was. On the contrary, I am the more anxious that it should be widely known both how good and how bad it was; how perfect in its inception; how avowedly imperfect in its performance. I did not dare to expect that my endeavour to spread the facts about Reis's invention would escape the tongue of calumny. I did not expect to find anonymous abuse reprinted unrebuked where I have found it.

Silvanus P. Thompson.

University College, Bristol,
Oct. 27th, 1883.

[Although we are glad to insert Prof. Thompson's letter, with its remarks anent ourselves, we think that our brief reply to our correspondent, W. C. Barney, in our last week's issue answers also as a reply to the above communication. When an article is unsigned it is understood to be editorial; therefore Prof. Thompson cannot fairly describe the reviewer of his book as an anonymous writer. Those responsible for the insertion of the article in *Science*—in which, by the way, we find but slight personality, and no trace of calumny and abuse—do not hide their identity.—EDS. ELEC. REV.]

"Reis: 'Parent' of the Telephone.

"*To the Editor of the* ELECTRICAL WORLD.

"SIR,—Mr. Berliner has given me, in your issue of October 6, which has just reached me, a very neat rejoinder, containing a number of interesting points. To ask space to reply to all of them in your columns would be to ask too extensive a favour at the hands of even the most gracious of editors. Therefore, lest I occupy too large a space in your columns, I propose to leave some of the less important of the issues to answer themselves, and will address myself to the main points now in debate.

"Mr. Berliner promises to 'lay bare Reis's methods' (methods—observe—not method) of transmitting undulations by the telephone; but on examining the results emanating from his weapon—shall I call it tomahawk?—by which the process of 'laying bare' is accomplished, I cannot find that he has done very much more than dig up a rather obscure passage about—no, not about a transmitter at all—about one of the receivers invented by Reis: the 'knitting-needle.' He comes to the conclusion, by looking at this passage in the description of a *receiver*, that the *transmitter* was not intended to transmit all that such a receiver could receive; but that it was only intended to transmit 'one half' of the undulations. Well, though the argument is rather mixed in its logical sequences, I am thankful even for the admitted 'one half,' and I congratulate Mr. Berliner on the fifty per cent. of undulations which he credits to this particular instrument of Reis. I will return to the remaining 'half' presently.

"Meantime, I would ask Mr. Berliner why, in his process of 'laying bare' Reis's methods, he confined his attention to one form only of the receivers of Reis. It so happens that Reis invented another form of receiver, most minutely described by Inspector Von Legat in his report on Reis's instruments. Why is the action of *this* receiver not to be considered equally important? In this other instrument there was an electro-magnet, and opposite its poles an armature, elastically mounted, and attached to a sounding board. The action of the apparatus was thus announced:—

"'The electro-magnet will be demagnetized and magnetized correspondingly with the condensations and rarefactions of the mass of air contained in the tube (of the transmitter), and the armature belonging to the magnet will be set into vibrations similar to those of the membrane in the transmitting apparatus.'

"Do these words not 'lay bare' something quite different from Mr. Berliner's suggestion that Reis intended to let the transmitter 'do' one half of the undulations, and the receiver the other half? Mr. Berliner says: 'In the modern system the transmitter does the whole, and *the receiver merely follows faithfully*;' but, surely, 'following faithfully' can only mean that the armature of the receiver is set into vibrations similar to those of the tympanum in the transmitter, and that is precisely how Reis described the action of his receiver as just quoted. It is perfectly clear that, in *this* form of instrument, at any rate, the receiver was to receive the whole of the vibrations—not 'one half'—and therefore it follows that the transmitter was to transmit the whole of them.

"But I come back to the 'other half' which Mr. Berliner hesitated to credit to Reis when he used the 'knitting-needle' receiver. Mr. Berliner bases his view upon a passage which he cites from Reis himself. I will quote the same identical passage, word for word, in order that I may explain the points he has missed. Reis in this passage is endeavouring to explain how the varying interruptions of the current can make such a needle vibrate; and he takes a simple case in illustration:—

"'But at every closing of the circuit the atoms of the iron needle, lying in the distant spiral, are pushed asunder from one another. At the interruption of the current the atoms attempt to regain their position of equilibrium. . . . . But if these actions follow one another more rapidly than the oscillations of the iron core, then the atoms cannot travel their entire paths, the paths travelled over become shorter and shorter the more rapidly the interruptions occur, and in proportion to their frequency.'

"Those are the words Mr. Berliner quotes. Let us see what there is in them. Firstly, Reis recognized that the iron or steel of the needle was made up of atoms, and that since the material possessed elasticity its atoms could be made to oscillate backward and forward. He also recognized that the iron needle had a tone of its own, in emitting which the oscillating atoms would have to oscillate with a certain frequency of motion; but that it was also possible for them to oscillate in longer or shorter paths, and in paths of longer or shorter duration, provided certain actions which were brought to bear upon them occurred more or less frequently than their own natural frequency of oscillation. He further remarks that, if these impressed actions occur more rapidly or frequently, the atoms will

not swing over such long distances; they will execute short quick vibrations instead of long slow ones, in which case they will not travel their 'entire paths.' I cannot find in the passage from Reis one single word about 'back-strokes' of the molecules, which Mr. Berliner seems to have found in this passage of Reis's memoir. It distresses me to say that I can't find anything of the sort even hinted at. I don't find anything about molecules striking, either against themselves or against anything else; much less that they have any 'back' strokes. They swing through longer or shorter paths, and swing quicker or slower, according to circumstances.

"I will ask Mr. Berliner kindly to allow me one moment's grace to 'lay bare' the action in a Bell receiver, of the common kind. The vibrating or undulating current comes along the line from the transmitter into the 'distant spiral' coiled upon the pole-piece of the receiver; that pole-piece in consequence acts, with corresponding fluctuations in its attraction, upon the atoms of the iron tympanum. That tympanum has, like all tympanums (and like the iron needle too), a natural note of its own—a *booming* note, if the tympanum be thin in proportion to its diameter. The iron is elastic; its atoms can oscillate, and can travel along paths of their own. But if the fluctuations of the current impress upon those atoms magnetic impulses with a different frequency, if the fluctuations of the current come more rapidly one after the other than the natural swing of the iron atoms, then those atoms composing the iron disk oscillate with a corresponding frequency of note, and travel in paths of longer or shorter duration. If these fluctuations in the transmitted current 'follow one another than the oscillations due to the elasticity of the iron' of the diaphragm, that is to say, if the transmitted sound is one of shriller pitch than the natural note of the elastic iron tympanum, 'then the atoms cannot travel their entire paths;' the paths travelled over become shorter and shorter, the more rapidly the fluctuations occur, and in proportion to their frequency.

"Why! when we 'lay bare' the action on the iron atoms of the diaphragm of the Bell receiver, it turns out that, so far as any question of oscillation of atoms is concerned, the effect of frequency in the fluctuations of the current is absolutely identical with the effect of frequency in the fluctuations of the current in the case of the iron atoms of the Reis needle! Given a fluctuating current, it will produce a corresponding fluctuating magnetic attraction on a neighbouring atom of iron, no matter whether that atom of iron be part of an elastic iron needle or part of an elastic iron disc. Both can vibrate, both will vibrate; and the duration of the oscillations will be shorter in proportion to the frequency.

"I say, then, most emphatically, that Reis, in describing the action of the current on the oscillations of the atoms of iron, had penetrated to the very heart of the matter; and the passage quoted by Mr. Berliner is the most convincing proof of it. I assure Mr. Berliner that he need not any longer hesitate to credit Reis with the 'other half' of the undulations. He has admitted that Reis intended to transmit fifty per cent. of the vibrations by an undulatory current. If Reis invented an instrument to work by undulatory currents for fifty per cent. of the vibrations—as Mr. Berliner admits—then, I think, he must be regarded as the inventor of undulatory-current-transmission, even if the other fifty per cent. be otherwise transmitted.

"Having disposed of this point, I turn to another. Mr. Berliner quotes from Reis's prospectus—a document which specially gives instructions how to indicate to the person at the transmitting end when he is to 'speak'—the following scrap:—

"'The circuit will be once opened, and again be closed, for each full vibration.'

"And upon the strength of this 'decisive language' he seems to think it proved that I am wrong in maintaining that Reis meant his interruptor to work by varying contact. According to Mr. Berliner, Reis did *not* intend his interruptor to interrupt the current in proportion to the vibrations; but to act in a manner that did not correspond to the vibrations at all. According to Mr. Berliner, a gradual vibration was *not* to interrupt the current gradually; a partial vibration was *not* to interrupt the current partially. And this is the sentence he quotes as a proof of his view.

"Well, what does the sentence say?

"It does not refer to the complicated vibrations of speech, to the regular undulations of the vowels, or to the abrupt agitations of the consonants. It does not even refer to the transmission of gentle musical chords. It is a much simpler case—the simplest conceivable. Reis, wishing to bring the very simplest case to the conception of an incredulous folk who would not believe that even a simple musical sound could be electrically transmitted, takes them to the instance of a single to-and-fro' oscillation. He tells them what will happen in the case of a 'full vibration.' That is all. He says the circuit will be once opened and again closed for every *full* vibration. He had previously said—or had got Inspector Von Legat to say it for him—that the contact-piece of his transmitter must 'follow' the movements of the tympanum of the transmitter with the greatest precision, or else the sound would be blurred in its transmission. And he knew, and gave diagrams to show that he knew, how complex were the vibrations of various sounds which his transmitter was to transmit. He drew diagrams of undulatory curves not consisting of 'full' vibrations but of vibrations of other kinds,—gentle gradations of pressure being indicated by gentle slopes in the curves. All these his contacts were to 'follow' precisely in perfect correspondence. He told the world what was to happen at each 'full' vibration: he did not add in any explicit manner what was to happen at any half-vibration or partial vibration. He left it to the common sense of mankind to see that if a 'full' vibration opened and closed the circuit, a half-vibration must half-open and half-close the circuit, It is absolutely certain that in the lever-form of instruments he meant the amount of opening and closing—the degree of interruption—to be proportional to the motion of the tympanum of his transmitter, for if it were not proportional, the result would have violated the principle he so emphatically laid down that the electro-magnet of his receiver was to be magnetised and demagnetised in proportion to the degree of condensation or rarefaction of the air in the transmitter. I cannot conceive any person of ordinary understanding reading the statement of this fundamental principle, and not seeing that this could not possibly be so unless the opening and closing of the circuit by the interruptor of the transmitter were an opening and closing strictly proportional in degree to the vibrations impressed by the speaker's voice. He intended his circuit to be closed in proportion to the air-pressure. He intended his interruptor to interrupt in varying degrees, corresponding to varying amplitudes of vibration. He never explicitly said so; he never seemed to think that any one would or could be so devoid of logical capacity as to require such elaboration of language. To have supposed otherwise would have been to violate the fundamental *principle of correspondence in the vibrations*. Once the principle of correspondence laid down, as Reis laid it down, common sense would show that a *partial* vibration must produce a *partial* interruption of the current, or it could not reproduce the *partial* vibration in the receiver. All that any modern transmitter does—Blake, Edison or any other—is to interrupt the current in proportion to the vibrations.

"Read Reis unbiassed by later ideas. Read his fundamental principle of 'correspondence,' as I call it. Apply it as a fundamental principle to interpret his meaning, and that meaning is perfectly clear.

"The failure of Reis to obtain all the complete results he hoped for—and he was one of those single-hearted men who honestly avow the imperfections of their own work—was not due, as Mr. Berliner thinks, to the falsity of his system. Mr. Berliner says it was 'solely' due to the falsity of his system. No. He

failed to obtain results as reliable as he desired, because his instruments had mechanical imperfections which prevented them from coming up in their performance to the perfect 'correspondence' in action which Reis's theory laid down.

"Did Reis lay down that theory of correspondence as a fundamental principle, or did he not? Any one who has read Reis's papers knows.

"I fear I have already trespassed too long upon the editorial fund of patience, and I dare not linger on the other minor points at issue. But I cannot lay down my pen without expressing my thanks to Mr. Berliner, firstly, for having so squarely raised the main issues, and, secondly, for having given me at the end of his letter such an exquisite little 'parable' in illustration of his view of the case. It is so apt, so delightfully apt, that I shall treasure it. Let me revive it here.

"'A child born in the wilderness loses his parents when he is not capable yet to intelligibly utter his wants. . . . When quite grown, and in his wild condition, he is picked up by a person of intelligence, who succeeds in teaching him how to talk and to learn, and he subsequently becomes a highly useful citizen of the State. To whom is the State most indebted?'

"Let me 'lay bare' this little parable. The child born in the wilderness had no natural impediment. He was not physically incapacitated from speaking: he inherited the organs of speech from his parents; but they were dead. He had a tongue made right, and lips, and lungs. His organs of speech were so constructed that when rightly operated they could produce those undulatory motions of the air which we call speech. He had even learned to mutter a few familiar words in his youth before his parents died, and when he sang songs the words were recognisable, said those who heard him. But after his parents' death he spoke to nobody, simply because nobody spoke to him. His failure to speak was not due to any imperfection in his own design or structure, or to any falsity in the system on which he was constructed, His lips were not so made that they must always be either wide open or tight shut. They could be half open, or a quarter open; they could open in any proportionate degree corresponding to the amount of muscular effort applied to open or close them. His ears, though clumsy, were perfect. The elasticity of the membranes or drumskins was such that the atoms could execute vibrations to and fro, and could travel on longer or shorter paths according to the forces acting on them. In short, his imperfections were solely due to disuse. People did not know or had forgotten his existence. Now comes the 'person of intelligence.' I would have preferred to say a man of insight and genius. He teaches the creature to talk and to learn. It is deeply touching. That man has deserved well of his country. He is a public benefactor. The parable is perfect.

"Only one detail remains. Mr. Berliner asks:—To whom is the State most indebted—the dead parents or the man of insight? Pardon me, that is not the question. The question is: *Who was the parent?* Yes! The parable is perfect.

"Only it stops short too soon. Let me take up my parable where Mr. Berliner lays his down. This is my parable:—

"'The State, having discerned what a great benefit had been conferred upon it by the person of intelligence in teaching the neglected child to talk, made a solemn decree to the effect that henceforth for fourteen years no man or woman in the entire State should be allowed to become the parent of a child except the aforesaid person of intelligence.'

"Silvanus P. Thompson.

"Bristol,
"*Oct. 26th*, 1883."

The Hammer Telephone.

I thank Mr. F. W. Cooke for so courteously answering my question. The exposition of his ideas, which he has made in his letter of October 29th, inserted in the number of the REVIEW for November 3rd, renders more easy my task of entirely confuting them, making use of his own arguments, and drawing the logical conclusions, which he has omitted to do.

I can perfectly understand that a theory, contrary to that generally received, should at first meet with incredulity, and that it is only by the force of argument, reflection, and examination of the question in all its aspects that one is forced to recognise, that there can be no other conclusion than that which I have formulated.

The example, quoted by Mr. F. W. Cooke, of the undulatory movement of a body of air enclosed in a tube, does not seem to me suitable.

For in this experiment we have the propagation of the sound by a *gaseous medium*, essentially *compressible*, of which all the parts are extremely mobile, relative to each other. M. Ganot did not generalise this law of propagation by condensed and dilated waves, by applying it to *solid bodies*, of which the parts cannot undergo these relative displacements.

Now, in the *Hammer telephone*, employed as a transmitter, we have the propagation of sound by solid bodies. The example, which I gave, of ivory billiard balls suspended in a straight line, and of which the intermediate ones transmit to the last the motion communicated by the first of the series, *whilst remaining themselves absolutely motionless*, is much more appropriate to the subject. Mr. F. W. Cooke will surely agree with me in this.

Mr. F. W. Cooke is, besides, very modest and reserved. His conviction is evidently not very strong, for he only gives it as an opinion, a supposition, an imagination.

"I *imagine*, it (the hammer) never separates (from the organ upon which it rests)."

How does he arrive at these conclusions, since he himself makes a distinction between the movements of the different "layers" of a body and that of the hammer to which the impulse is communicated?

"The hammer or lever, *being free to move*, undergoes *bodily* as well as molecular displacement."

Well, if on one hand the hammer is *free to move* in relation to the fixed body, if on the other hand *the displacement of the lever is bodily*, whilst it is only partial and successive for the parts of the body, what must we conclude?

Evidently that the hammer must separate from the body!

Instead of concluding, as Mr. F. W. Cooke does: "But only in proportion to the elasticity of the organ, from which, I imagine, it (the hammer) never separates."

On the contrary, we must say:

And in proportion to the elasticity of the organ the hammer must separate from it.

Now, let us leave what Mr. F. W. Cooke calls "*the molecular disturbance*," of which he examines the effects, because no one can say what that means, and which is, moreover, needless for clearly explaining the phenomena as follows:

The movements communicated to the armature lever in the magnetic field engender in the bobbins electric currents of a duration equal to that of these movements, and of an intensity proportional to their amplitude, and especially to their velocity.

But these movements of the armature must be extremely short, since, when the hammer is separated from the organ, no sonorous impulse can reach it, and consequently the magnetic force continues, rapidly annihilates the movement produced by the *instantaneous* force of the shock and restores the armature to its original position.

The currents sent on the line will be, therefore, sudden, of infinitely short duration, and in no way *undulatory* as defined by Bell.

I might say more, but I am only making a reply and not a complete exposé of the subject.

Leon De Locht-Labye.

24, Langham Street, Portland Place,
November 4th, 1883.